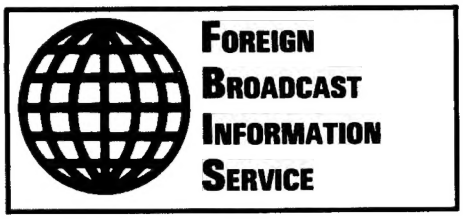
JPRS-UST-89-005
30 MARCH 1989



JPRS Report

Science & Technology

USSR: Science & Technology Policy

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JPRS-UST-89-005 *30 MARCH 1989*

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General

Academicians Discuss Need for Selecting Directions for Basic Research

18140140 Moscow PRIRODA in Russian
No 1, Jan 89 pp 16-23

[Article by Aleksey Mitrofanovich Kutepov and Vladimir Ivanovich Kuznetsov: "Selecting Directions for Basic Research"]

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The need for the rapid development of basic scientific research, stated in the resolutions of the 27th CPSU Congress, is of fundamental significance for intensifying social production. Precisely basic research, aimed at discovering the yet unknown hidden laws of nature, can lead to scientific results capable of laying a foundation for fundamentally new production and opening possibilities for a sharp increase in labor productivity. As opposed to basic research, applied research is based on already known laws of nature and fixed principles, applying them to the front of existing material production and only improving it. Only basic research can provide a level of integration of material and spiritual production, such that there will no longer be a need to overcome the resistance that arises today in the process of "applying" laboratory results in industry.

It is a question of creating highly science-intensive[1] sectors of industry and, simultaneously, industrially developed sectors of science in which scientific laboratories with small, compact installations are capable of performing the functions of industrial production and of developing multi-ton production. The recently created laboratory methane plasmatron, made in the GDR by scientists from the GDR and the USSR, with a capacity of only 20 liters, is operated by one laboratory technician (!), but produces 25 tons of acetylene every 24 hours, i.e., an amount equivalent to the productivity of an entire plant. Today, this kind of scientific achievement is no longer fantasy, but the real future of the development of science and industry.

Therefore, it is no accident that the idea of the priority significance of basic science, which elevates social production to a qualitatively higher level, is being put into practice with increasing persistence today. However, the implementation of this idea often occurs spontaneously, without the proper theoretical interpretation which is particularly important in solving this task. The point is that basic science (both as a bank of accumulated information, and as work to produce knowledge) is not an unstructured aggregate of scientific data and procedures for obtaining them. Therefore, treating it as something promising, without taking its structure and component parts into account, is fraught with shortcomings, similar to those inherent in prospecting for valuable ores without knowing the laws of ore formation.

The Hierarchical Structure of Chemical Knowledge

The sharply declining efficiency of basic research (conducted by highly skilled scientific forces) in one of the leading fields of chemistry—organic synthesis—is an alarming witness to the existence of this kind of shortcoming. Even in the 1950s, Academician N.N. Semenov, whose alarm was shared by few at the time, turned attention to this shortcoming. Today, this shortcoming has become particularly tangible and is causing general concern. Perhaps, the most correct answer to the question of what caused it is given by Semenov's very same considerations, recently quoted by Professor A.F. Pozharskiy, Rostov University, taking the present-day state of affairs into consideration.

The essence lies in the fact that among many chemists in our country, starting in the 1950s-1960s, a not entirely groundless concept was formed, according to which the era of classical organic chemistry (with organic synthesis in the main corner) is somewhat on the decline; quantum mechanical calculations of molecular structure and other problems of structural chemistry are being advanced to first priority. This concept spread in broad circles of researchers because, on the one hand, it relied on the authority of quantum mechanics and quantitative research methods and, on the other, it made it possible to reconcile oneself to the poor provision of our laboratories, particularly VUZs, [Higher Educational Institution] with instruments and reagents. As a result, one withered branch after another began appearing on the tree of our science, and our country is now forced to pay millions in foreign currency rubles, which are being spent to acquire the missing chemical commodities abroad, because of the negligent management of basic science.

These omissions have deep gnosiological roots. The point is that in chemistry the classical concepts of structural theories as the apex of chemical knowledge had been absolutized for a long time. In the 19th century,

these theories actually ensured the triumphal march of organic synthesis, but in the early 20th century, a number of very important sectors of chemical industry became basic. Since the 1930s-1940s, the penetration of the principles of quantum mechanics into chemistry served as the physical grounds for phenomenological structural theories and it strengthened the concepts of their fundamentality, heuristic nature and indispensability even more. Chemistry, at least until the 1950s, had no idea whatsoever of a hierarchy of levels in chemical knowledge, about the prospects for their development, leaving the bounds of the study of molecular structure.

However, the fascination with the merits of structural chemistry could not last long. The development of the automobile industry, aviation, power engineering, and instrument building in the 1930s—1950s made new and unusual requirements—materials were needed with strictly assigned properties in unprecedented scales: high octane motor fuel, special lubricants, special rubbers and plastics, highly stable insulators, heat resistant organic and inorganic materials, and semiconductors. Methods based on structural theories were no longer suitable for obtaining these materials: they did not ensure the economically feasible output of products, were oriented toward raw material of a vegetable origin, including food resources, and were devoid of possibilities for the flexible control of technological processes. The classical thesis, on which these methods were based, of the dependence of the properties of any substance on its composition and structure was only fulfilled by half. In fact, the properties of a substance, interacting with another substance in the course of a chemical reaction, do still depend on the structure and composition of the latter. However, the second substance might be not only the intended coreagent, but also any other thing that turns up in the reaction zone.

In 1954, Semenov was the first in our country, and one of the first scientists in general, to raise the task for chemists of converting to a new, higher level of chemistry, in which the reagent molecule should be viewed as just one of the component parts in an overall system consisting of the coreagent, the reactor walls, catalysts, solutions, admixtures, and any other substances—the participants in the chemical process.

About 35 years have passed since that time. In this time, concepts of the hierarchical structure of chemistry were gradually put together, based on numerous factual data, including achievements obtained by Semenov's school in the field of chemical kinetics. Incidentally, the first step toward clarifying this structure was made by D.I. Mendeleyev, who expressed the idea to the effect that seeking that which is unified and common in the variable and in the particular comprises the basic task of knowledge.[2] The task of defining properties as the key to solving the production problem of obtaining materials with assigned properties is such a unified and invariable thing for chemistry. This problem is the core of chemistry. Its most important feature is the fact that it has only four methods of solution—the properties of the substance, and hence also the methods for changing them and chemical technology depend on: 1) elementary composition; 2) structures; 3) reaction kinetics; and 4) capability of self-organization. It is possible to relate chemistry's degree of development to the change in methods for solving this problem. In this respect, chemistry and the chemical industry act as a unified, developing system which includes four hierarchically related levels in chemical knowledge: 1) the study of composition; 2) structural chemistry; 3) study of the chemical process; 4) evolutionary chemistry.[3]

The Problem of Intensifying Chemical Industry

In order to imagine the specific features of these levels, as an example we shall consider the solution of the same problem, the synthesis of rubber, at the three upper levels.

In the 1920s-1930s, when a very urgent need for rubber for the aviation and automobile industries arose, yet capitalist countries had banned its sale, our chemists succeeded in developing a method for synthesizing rubber. Throughout the world, this success was deemed a great achievement of basic science. The production of this most valuable strategic product was set up in the USSR even in the early 1930s. However, outlays for it were unusually great: hundreds of thousands of tons of grain or potatoes went into the manufacture of ethyl alcohol, from which monomer divinyl was obtained at 28

efficiency, and from this—rubber. Taking the production of agricultural raw materials into account, the labor of no less than 150-200 thousand people was spent annually to obtain rubber. There were no other technologically or economically more efficient methods for producing rubber. And there could not be, due to the limited nature of the achieved level in the development of chemistry.

At the new level of chemical knowledge, founded by Semenov in the 1950s, rubber was produced from monomers obtained from petroleum raw materials. This method provides for high growth in the production of various types of synthetic rubber with fewer outlays of manpower and energy by a factor of 20-30, and the complete rejection of edible raw materials. However, even this is not the limit. It is possible to increase labor productivity in chemical plants a hundredfold.

As a result of basic research at the level of evolutionary chemistry, it has already been proven in principle that the cumbersome industrial installations for obtaining monomers, each of which is operated by 180-200 workers, could be replaced by plasma pyrolysis devices with the same productivity, but only 1 cubic meter in size, controlled by one or two workers. This is nearly science

fiction, but is already approaching industrial implementation: these installations have undergone laboratory tests. In this connection, energy outlays per kilogram of output are reduced from 5-6 to 3 kilowatt-hours.

Currently, basic research in chemistry is implemented at all four levels. However, at the first two levels it leads to results which are basically only significant for extensive development of the chemical industry. At the third level, it provides for the intensification of industry primarily by increasing the unit capacities of industrial installations. For example, an old installation for producing ammonia from nitrogen in the air and hydrogen, obtained from methane, with a capacity of 200,000 tons per year is operated by 810 workers, yet an installation of the new design, with a capacity of 400,000 tons per year—by only 70 workers. At the fourth level, basic research leads to results that provide for the intensification of industry due to fundamentally new and, as a rule, flexible and waste-free technologies. Precisely as a result of research, it was established that, for example, it is significantly more advantageous to use nitric oxide than ammonia to produce nitrogen fertilizers. Nitrogen and oxygen from the air serve as the raw materials for nitric oxide, which entirely eliminates the preliminary and expensive production of hydrogen from methane for the synthesis of ammonia. Energy outlays per ton of output are reduced by a factor of 2-3, and the cubic size of the reactors per unit of capacity is reduced by a factor of 10-15.[4]

As a result of research at the evolutionary level, scientists at the USSR Academy of Sciences Siberian Department Institute of Catalysis have made radical changes in our knowledge of the basic laws of catalytic processes and, as a consequence—in chemical technology. The foundations of so-called non-stationary technology have already been created.[5] It turned out that it is possible to replace strict functional ties between groups of chemical installations, cumbersome equipment, wasteful energy use, and inconvenient process control by compact equipment with flexible mechanisms for regulating the energy self-support and self-maintenance of processes. The efficiency of this kind of change is tremendous and it is already being implemented by the "Katalizator" Intersectorial Scientific and Technical Complex (MNTK), created in 1986 and including the scientific institutions and enterprises of different departments.

Thus, the most important discoveries for intensifying chemical industry should be expected from basic research work at the third and, in particular, fourth levels.

Universality of Hierarchical Concepts in Science

However, the hierarchy of levels of scientific knowledge as a criterion for defining the most promising directions of basic scientific research are not only spreading in chemistry. It began to operate in physics significantly before chemistry. The discovery of the methodological principle of correspondence in 1918 by N. Bohr served at the time as a powerful impetus for the revelation of at least the first two stages in the development of physics: Newtonian and wave mechanics. This was immediately "employed" by W. Heisenberg, who constructed a hierarchical ladder from five "conceptual systems of physics," or the five levels of development of physical knowledge, upward movement along which offered promising prospects.[6] There is no need to mention in more detail the fact that the further development of basic research in physics has been based on the active implementation of the logic of the development of science, including the use of hierarchical models for the different stages of knowledge, since the 1920s.

Both in Soviet, as well as in foreign literature, the hierarchical structure of scientific knowledge was considered as applicable to other sectors of natural science. It was noted, in particular, that modern biology was lifted to an incomparably higher level in its own development, after incorporating fundamentally new, with respect to classical, ideas about integrity, systems nature, organic determinism, etc. Therefore, it is possible to conclude that biologists also arrived at specific hierarchical models for their science, capable of adequately reflecting both its history, and its future as a replacement for the extensive paths of development with intensive ones, as a sequence of specific scientific revolutions that cause the appearance of an increasingly higher order of biological knowledge.

Finally, today we can already speak boldly of a fundamentally new approach to studying the laws of the development of all natural science on the whole. Obviously, one should set the different views of the solution of the space-time problem as the basis of this approach (according to the works of Nobel Prize winner I. Prigozhin). In the history of natural science, which arose in the New Age (of physics, chemistry, biology, and sciences of the heavens and Earth), the first two levels of this development are clearly obvious: Newtonian and relativistic mechanics. To put it briefly, space dominates in the first level, and in the second—space and time are equivalent. However, in both this and other levels, the doctrine of the universal reversibility of processes which occur in nature prevails; irreversibility is represented as a particular feature, leading to increased entropy, from order to chaos.

However, the voices of natural scientists on the leading role of time as a characteristic of natural processes are being heard ever more persistently and conclusively today. Strange though it may seem, natural scientists only recently realized that the one-directional nature of time must be taken into count. The theory of the predominance of irreversibility in natural processes is becoming the basis of a natural science ideology. It is winning its own position not only in theoretical polemics, but also in the new evolutionary theories in physics, chemistry, and biology which provide for the appearance of fundamentally new industry and increase of labor

productivity by factors of hundreds and thousands. The main operating principle of these theories is the principle of historicism, which has become the emblem of the new—the third level of the development of natural sciences.

The Principle of Historicism in Science

A noteworthy feature of scientific knowledge at the level of the evolutionary theories is the synthesis within them of the latest achievements in "opposite" fields—the fields of extreme states (in chemistry, (4-10) x 10^3 °C) and fields of normal pressures and temperatures—"the vessel of life." These two extremes are joined by the principle of historicism, which until recently was only developed in the documents of evolutionary biology and social sciences. Today, it has become a guiding principle both in chemistry, as well as in physics, particularly after the publication of I. Prigozhin's works on the thermodynamics of non-equilibrium processes.[7] We know that the length of an elementary chemical reaction can reach 10^{-13} seconds, but under the conditions in which chemical processes occur in present-day factory practice, such speeds are excluded by a whole series of unfavorable factors, particularly by the equilibrium of direct and reversible reactions: the second lowers the speed of the first to the permitted thermodynamic limit.

Extreme factors or a catalytic influence which emulates the "laboratory" of a living organism almost entirely eliminates the reversibility of reactions and, thanks to this, conditions arise for achieving the maximum possible speed. This is why a reactor with a 1 cubic meter volume, operated by one person, can in principle replace an entire plant with several thousand workers.

Today's evolutionary ideas are swiftly encompassing all fields of natural science. However, even in the 1950s, the question of the origin of "forms"—electrons, atoms, molecules, etc.—had not arisen in a single sector of natural science, with the exception of biology. All of these "forms" were constructed from less complex particles, like a building from bricks. "For us, confirmed physicists," wrote A. Einstein, "the difference between the past, present, and future is nothing more than illusion, although a persistent one."[8] Only biologists were unable to construct a plant or animal, and were therefore forced to resort to the principle of historicism and seek a way for the evolution of matter. However, even in the 1960s, chemistry was the first to turn to solving evolutionary problems, without which it would simply had been unable to progress forward in studying the qualitative transformations of substance.

To this day, a large number of scientific and popular articles, monographs and collections have been published on the problems of evolution. However, life demands formulations of scientific research works which, on the one hand, would intensify our knowledge of the specific mechanisms for the evolution of material systems (which is needed to sharply increase industry's efficiency) and, on the other, would become a basis for new progressive technologies. Such works, it seems, should be forced at least in two directions: first, in the direction of intensifying the production of new materials with assigned properties under the extreme conditions which ensure the irreversibility of the process, or "far from equilibrium," as they are called in non-equilibrium thermodynamics; second, along the path toward assimilating the experience of living nature, accumulated in the course of biological evolution, to produce ferments, hormones, plant growth stimulators, food proteins, and products of organic synthesis in general, to develop biotechnology, emulate photosynthesis, etc.

How To Create Tomorrow's Technology

We should relate the entire already fairly broad set of pioneering work, concerning the use of plasma, laser radiation, the self-propagating high temperature synthesis (SVS) method, etc., to the first direction of research. In this respect, the work on plasma chemistry, mentioned above, is instructive. Today, we can speak with certainty of the invasion of plasma technology in industry as a revolutionizing factor. Using plasmatrons, we are beginning to convert all possible waste products from the chemical industry into commodity production. Plasma is being used to sharply accelerate steel welding (it should be noted that the world's first plasma ovens were created by the joint efforts of USSR and GDR scientists). In combination with vacuum-induction fusion, plasma makes it possible to obtain particularly high quality steel from non-standard raw materials. The American "Multi-Arc" Company, which acquired the rights to the creation of the Soviet "Bulat" vacuum-plasma installation and the production of instruments with a strengthening coating deposited using this device, emphasizes in its advertising prospectus: "This is not simply an improvement. This is a technological revolution. This is tomorrow's technology for today's production."

Work in the field of thermal processing, cutting, welding, and the surface strengthening of metals and metal ceramics, where powerful energy media, such as electron pencils and electric-arc plasmatrons are used, and where increases in energy density by a factor of millions are achieved due to the use of lasers, can serve as a reference point in research in this direction. For example, the All-Union Scientific Research Institute For Electrothermal Equipment (Moscow), jointly with the Special Design Bureau of the Saratov Electrothermal Equipment Plant, have developed a method for plasma ion processing of the surfaces of instruments, whose wear-resistance increases by a factor of 4, has been developed. The plasma-mechanical processing of manganese steels and titanium alloys, as compared to their usual tempering, increases labor productivity by a factor of 10-15.[9]

The SVS method creates truly the broadest prospects for intensifying the production of new materials. As opposed to traditional methods for baking metallic powders, it makes it possible to sharply reduce labor and

energy outlays in producing metal ceramics, somewhat strengthens the equipment and entirely eliminates the need for heating and pressing powders. Of course, the cited examples only attest to the very first steps in solving the basic problems of science with regard to irreversible processes, occurring under extreme conditions. Not only the use of these processes in equipment, but also a deeper study of the phenomena of irreversibility and self-organization themselves, which not long ago were "forbidden" for classical thermodynamics, are on the agenda.

As far as the second direction of research is concerned, it covers a broader range of problems, making up a new level of scientific knowledge. This includes the problems of bionics, in the broad meaning of the term: the emulation of biocatalysts, the development of abiotic catalytic systems and non-stationary technology, membrane technology, biotechnology, the chemistry of immobilized systems, biogenesis in all its aspects, and the imitation of a green leaf in order to obtain a high-calorie and ecologically perfect fuel—hydrogen—from water with the help of sunlight (including diffuse). The solution of these problems is only at the beginning stage, but is already bearing fruit. It is an important prerequisite not only for accelerating the application of laboratory results in industry, but also for reinforcing the ties between science and industry, in particular for creating the MNTK and NPO [Scientific Production Association] as the organic whole of research and production elements.

Practice has shown that the MNTK and NPO reduce the cycle for creating and applying new equipment and technology in our country by a factor of 1.5-2. The reserves here are tremendous. The development of basic scientific research at the highest levels of the development of contemporary natural science can serve as a powerful factor for putting these reserves into practice.

Of course, the criteria for selecting the most promising directions of basic research are not limited by these factors alone. Economic, social and other factors, consideration of which, however, is impossible beyond the ties to the laws of the development of science, also relate to these criteria. Therefore, the main goal of this article is to show the erroneousness of a simplified, overly abstract approach to the question of the priority role of basic science, and to direct attention to the dialectical nature of its development, the study of which makes it possible to see the most likely fields for revolutionizing scientific discoveries.

In conclusion, we would like to direct attention to yet another important aspect of the problem of selecting the most promising directions in the development of individual natural sciences. Not only scientific researchers, but scientific teachers as well should at the very least be involved in solving this problem. Today, our VUZs are training engineers and scientific workers for the start of the third millennia, when science and industry will be significantly different than they are now. We are instructing students basically with textbooks from the 1950s and 1960s, informing them at best of the main achievements of science in the 1980s. What must be done, so that flexible methods for the instruction and education of future specialists correspond to the flexible technologies now being applied in industry? The answer is simple. First, we must not tolerate the absolutization of the data of contemporary science either in text books, or in lectures, since "that which is called truth today, has its own erroneous aspects which are hidden now, but will come to light in time; and it is entirely so, that that which is considered wrong today, has a true side."[10] Unquestionably, science in the 1990s will bring this kind of change. Secondly, scientists who teach in VUZs should see the immediate prospects for the development of their science. In order to do this, no other reliable way exists, besides the study and dialectical extrapolation of its development, besides the ascent from dialectical abstractions to their specific interpretation in the logical, hierarchical structure of this science.[11] Only from these stances is it possible to choose the directions for basic research.

Footnotes

1. By definition, accepted in many countries, a sector of industry in which outlays for scientific research and development exceed 5 percent of the production cost is considered science-intensive.

2. D.I. Mendeleyev, "Izbr. soch." [Selected Works]. Vol 2, Moscow; Leningrad, 1934, p 381.

3. The fourth level in the development of chemistry is also known as "the doctrine of the evolution of non-equilibrium chemical systems" or "generalized (non-equilibrium) chemical kinetics," which has become the theoretical basis of plasma chemistry.

4. See: L.S. Polak and A.S. Mikhaylov. "Samorazvitiye Neravnovesnykh Fiziko-khimicheskikh Sistem" [Self-development of Non-equilibrium Physical and Chemical Systems]. Moscow, 1983.

5. Regarding non-stationary technologies, see: Yu.Sh. Matros. ZHURN. VSES. KHIM. OB-VA. 1977, Vol 22, No 5, pp 576-580.

6. See: W. Heisenburg. "Physics and Philosophy." Moscow, 1963.

7. See: I. Prigozhin and I. Stengers. "Poryadok Iz Khaosa" [Order from Chaos]. Moscow, 1986.

8. Quoted from: I. Prigozhin, "Ot Sushchestvuyushchego k Voznikayushchemu" [From What Is to What will Come]. Moscow, 1985, p 203.

9. G.I. Marchuk. NAUKA I ZHIZN. 1985, No 6, p 6; No 7, pp 3 - 5; No 8, pp 2 - 7; No 9, pp 2 - 5.

10. K. Marks and F. Engels. "Soch." [Works]. Vol 21, p 303.

11. Ibid. Vol 20, pp 538; 565-570.

Organizational, Personnel Problems Affecting Basic Research

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[Article by Academician V. Nakoryakov: "Authority of Talent"]

[Text] **Restructuring has forced us to look the truth in the eyes. It has become clear that our national income is growing basically due to unnecessary production, and the correlation between consumption funds and accumulation funds leaves no hope for a noticeable increase in the standard of living. We have realized that we live in a country with a deformed price structure and that planning in a monetary expression simply misleads us, since it does not reflect real labor outlays. Having discovered that traditional enterprises dominate our economy, we are forced to admit that we have missed the start for the dash toward science-intensive industries, towards new biological, resource-conserving, and ecologically safe technologies.**

It would seem, there is chronic shortage everywhere and we should urge on our initiative in everything. However, judging by everything, initiative has remained in the category of things punishable. Our ministries and departments are not rushing to improve the work of their enterprises. Moreover, they are trying at any price, including that of provoking government agencies, to rid themselves of any appearance of competitors. Hence, the diktat of the producer is being preserved, and, as a consequence, industry's complete indifference to the achievements of science. This is also a direct threat to restructuring.

When society's interest in science is belittled, as a rule, basic research is the first to suffer. Today, of course, after the 19th Party Conference, no one would openly raise the question of reducing basic research. However, proposals to "earth" academic science and make it dependent on orders from enterprises and ministries are already being made. There are also arguments for the following: resources are needed to feed and clothe the country, to provide a roof over the heads of the needy.

Indeed, it is hard to object to this. However, I think it is my duty to caution that our children and grandchildren will scarcely be grateful to us, if they go into tomorrow's computerized world with a full stomach, but an empty head. Only basic research enables a person to remain at a peak position, arming him with new knowledge. Moreover, the outpacing development of basic research can serve to guarantee a country's sovereignty.

This conclusion is of fundamental significance to us. It would be naive to hope that we will be able in all areas to overcome the lag by purchasing equipment and technologies abroad. Indeed, there are tremendous advantages to the international division of labor, which must be used. However, any country, entering this path in the position of a "poor relative," is threatened with the danger of foreign political, economic or ideological interference in internal affairs. Therefore, it seems to me, the development of new science-intensive industries on the basis of breakthrough achievements in basic science can finally be accepted as our strategy.

How much should be spent on basic science in order to do this? The most precise answer is: the more, the better. In basic science, the rule that every kopek invested is paid back a hundredfold operates without fail. Moreover, he who is stingy pays twice. It is easy to be persuaded of this by the Americans' experience.

In the late 1960s, President R. Nixon announced that American industry would not succeed in mastering the avalanche of scientific achievements. So, he signed draft legislation which considerably reduced the financing of basic research. However, after only a few years, the country already felt the shortage of bold ideas and the development of science, engineering and society on the whole was threatened. The omission had to be rapidly repaired at the price of forced investments. In the United States today, industry and the state annually allocate more than 20 billion dollars for basic research.

Unfortunately, even taking exploratory work in both the civil sectors and the military complex into account, our investments in basic science are somewhat more modest. Hence, both the limited front of research, and the weak concentration of forces on decisive directions, as well as the low level of provision of our laboratories with instruments and computer hardware. One of the consequences is the reduction in the international authority of our science, in the number of publications in foreign journals, and in references to our work.

However, if I were told that golden rain would pour down on the academy tomorrow, I would not be able to guarantee that our science will suddenly leap forward. There is a key element in its development as a component part of society—the problem of generations. Therefore, I am not inclined to blame our problems on poor material support alone. The passivity of the young generation entering science disturbs me far more.

Basic science is kind of like theatre, which needs bright, talented performers with a romantic spirit. Devotion to the work, readiness to dedicate many years of one's life to it, and scientific principle-mindedness are the qualities which determine success. Unfortunately, the years of stagnation have devalued them. An atmosphere of leveling and mediocrity, conformity, and mercantilism,

have reigned in science. Today, in the eyes of a significant part of our society, a scientific researcher's labor has little prestige. The scientific administrator seems to be the main figure.

Breaking this stereotype is one of our first-priority tasks. We must restore the authority of the researcher, founder and leader of the scientific school. We do have people to compare ourselves to. The Academy of Sciences remained a bastion of independence even in the gloomiest years. The civic position of leading scientists, such as Academicians P. Kapitsa, M. Leontovich, I. Tamm and a number of others, helped protect Soviet physics from an utter defeat, like that to which genetics was subjected.

It is precisely such scientists who should be given preference in the elections to the academy. The upbringing of our scientific successors should be entrusted to them. The recently formed practice, by which young scientists are singled out for the independent collectives, is hindering this to some extent. For me personally, this path seems mistaken: the passing of the baton between generations is cut short.

It would be appropriate to ask ourselves the question: Can a young scientist become a laboratory chief in 30-35 years? In the early 1970s, such appointments were a common phenomena at the Novosibirsk Akademgorodok. Yet, now there are practically none. Why? The bureaucrats thought up a whole ladder of positions, in order to prevent the institute leaders themselves from setting the wages for associates. The main leading scientific associates, as well as those who are in no way leading, are lined up along the path to the laboratory chief's chair. An entire lifetime is not long enough in order to be in their roles.

The conscription of students into the army is having a catastrophic effect on the preparation of young cadres for science. This emotionless machine reduces everyone to the same level, knowing no exceptions. "Do not create a precedent!"—this has been the officials' main justification for making the most destructive decisions. Having worked as a rector of Novosibirsk State University, I can say that a 2-year break in studies virtually entirely destroys the system, shaped in the course of 30 years, for preparing young people chosen from throughout Siberia. After service in the army with its discipline and infamous "hazing," talented youths do acquire worldly refinement. However, they totally lose their youthful receptivity to knowledge.

As a legacy from the stagnant period, we have also received the standard line for housing which was introduced in academic collectives. Neither the institute director, nor the scientific council can, as was done before, invite a talented young scientist to work and give him a roof over his head. Obviously, this procedure leads to stagnation in the renovation of cadres. Taking low wages and the incentives for young people to join scientific and technical cooperatives into account, the threat of being left without scientific successors seems real.

We have tied many hopes for solving these and similar problems to the new conditions of work, which academic science is converting to as of this year. However, for the present time these conditions are far from perfect. In particular, the extraordinary gamble on the system of "grants," the allocation of resources for a proposed idea or project, causes doubt. History attests to the fact that there no discoveries have been made according to instructions. Indeed, the directions of basic research should not be defined by the customer—they should be dictated by the internal logic of science's development. Of course, this does not exclude performing economic contract work, which is a logical continuation of basic work, in the academy.

In order to realize the opportunities that are opening up, increased flexibility must be given to the internal structure of institutes. Laboratories, working independently on their own scientific programs with partial use of internal cost-accounting, should be the main elements. The idea of temporary laboratories, created to solve individual applied and basic problems, also seems promising.

For instance, one such laboratory, with the participation of associates from our Institute of Thermal Physics and specialists in industry, in a very short period of time, has advanced greatly in designing and engineering a system for the plasma stabilization of combustion, important for power engineering. A youth laboratory has managed to obtain the best thin "hot" superconductor film in the country using man-made sapphire.

Recalling the problems with application, caused not only by departmental disunity, but also by the exceptional complexity of the innovations being proposed, it is worth considering the organization of science-intensive industries directly in the academy system. The USSR Academy of Sciences Siberian Department, in particular, would be able to take up the production of small-series unique instruments, catalysts, devices and machines, incorporating the best of our developments.

Furthermore, I am certain that the path to the large-scale implementation of scientific production lies through applied institutes. Meanwhile, unfortunately, they are scattered among the ministries and departments, which complicates joint work. Some of them are also incapable of proposing modern technology, since they long ago broke away from both basic science, as well as industry.

In order to put things in order here, the most powerful applied institutes should be made subordinate to the USSR State Committee on Science and Technology. It would then be given an opportunity to solve large intersectorial problems, coordinate basic and applied research, track the use of obtained results, and fill the

orders of industry and other sectors of the economy. In order words, a unified scientific production line, aimed at solving the problems of restructuring, would appear.

Radical Reforms Needed To Improve Science, Industry Links

18140146 Moscow EKONOMICHESKAYA GAZETA in Russian No 4, Jan 89 p 15

[Article by G. Prazdnov, doctor of economic sciences: "Science and Industry: Forms of Interconnection"]

[Text] The radical economic reform was called upon to raise the receptivity of the national economy and enterprise collectives to the latest scientific developments and progressive technologies, and to find new forms for linking science to industry. For the time being, the large scientific potential that our country has at its disposal is far from fully utilized. Although the USSR holds first place in the world in terms of the number of inventions registered annually (about 200,000 studies and developments), the extent of their application is very low. Over a number of years, for example, only one-third of domestic inventions were applied in the economy. Moreover, each was used in only 1-2 enterprises! Indeed, science itself *still* lags behind the needs and requirements of industry. Yet, after all, as noted by a report at the 19th All-Union Party Conference, "unnecessary" science will die out sooner or later, and with this attitude toward scientific knowledge, practice becomes blind and decays.

What opportunities are opening up during the radical economic reform for raising the outcome of scientific labor and for rapidly applying scientific and technical novelties?

Cost-Accounting Incentives

Scientific, engineering, technological and design organizations, figuratively speaking, have been removed from the state content with the conversion to cost-accounting. They should "support" themselves and their employees at the expense of the obtained profits. Of course, financial resources are being allocated for scientific development. However, now problems are being financed, not institutions; not the content of the collectives, but specific scientific research and design work. Scientific organizations have now become socialist commodity producers, along with industrial enterprises, and their production has acquired commodity status. In this regard, the main thing is encouraged—the effectiveness and quality of scientific production, inherent in the development of promising items and in the creation of progressive base and fundamentally new technologies.

The need for such measures is obvious. Even if we consider machine building, the most developed industrial sector in the technical respect, among all projects completed in 1987 in sectorial scientific research institutes and design bureaus, only 6.1 percent related to the highest technical level of the best domestic and foreign developments. Meanwhile, projects containing inventions made up 35.8 percent in USSR Minavtoprom, 30.2 percent in USSR Minselkhozmash, and only 25 percent in USSR Minpribor. That is, many organizations had forgotten how to create pioneering technology. This is why the further existence of such "fruitless" scientific institutions is not only senseless, but also disastrous for the economy.

Right now, a significant segment of the sectors' scientific potential is transferred directly to industrial and scientific production associations and to large enterprises. For example, in machine building 75 percent of all scientific institutions have already joined them.

The economic methods of management are introducing serious corrections in interrelations between developers and customers. Now, enterprises are trying to spend money to benefit themselves. As a result, their demand toward the technical and economic level of development work has significantly increased. Customers are demanding shorter time periods for ongoing development work and are refusing to accept developments for implementation that do not promise a considerable economic effect. For example, according to USSR GKNT data, at the beginning of 1988, in the more than 200 scientific organizations studied, about 18 percent of previously concluded contracts were not extended, being unsatisfactory to the consumer. This has spurred many scientific organizations to exclude non-topical and ineffective research and development work from their thematic plans. Thus, 450 thematic areas, or one-fifth of all subject matter, were halted at the "Tulachermet" NPO.

The problem of stimulating basic research still remains unsolved. The attractiveness of contracts directly with enterprises has led to a sharp decline in the number of exploratory themes. In many types of new technology, the scientific surplus is beginning to be lost, since designers are not finding customers for it. This is fraught with the consequent that after 5-10 years the national economy will be lacking many new machines, technologies and materials. Therefore, a very difficult question arises regarding the sources of financing for basic scientific research.

It is also necessary to reinforce science's experimental production base, which needs significant capital investments that science still does not have at its disposal. Data exist to the effect that the capital-labor ratio in a scientific research institute or design bureau is lower on the whole, than it is in industry, by a factor of over 2. Meanwhile, for example, only the use of automated design systems (SAPR) can reduce the time period for creating the design and estimate documentation by a factor of 3-4, and significantly raise its quality.

In short, it is impossible to rapidly achieve breakthroughs in basic research and successfully implement the whole set of planned programs for our society's socioeconomic restructuring without a qualitatively new material base.

Flexibility of Organizational Structures

The potential of basic and applied science builds up over the years and decades, but its use can either be slowed or accelerated. One factor in acceleration is the democratization of relations in science and overcoming bureaucraticism, administration, conservatism and monopoly. In collectives where conditions are being created for discovering talents, for manifesting creative initiative, and for competitiveness and rivalry among scientific ideas and opinions, good results are being achieved. Practice has proven the expediency of various forms of organization of scientific research, of the sensible combination of state and cooperative forms.

Recently, different forms of interrelations between science and industry have taken shape in the country and are functioning successfully: scientific-production and intersectorial scientific and technical complexes, scientific production associations, engineering centers, temporary scientific collectives, and scientific and technical cooperatives for solving target problems on a competitive basis.

The plant sector of science requires particular attention. It includes laboratories, special and experimental design bureaus, chief designers' departments, experimental shops, etc. For example, there are about 90,000 such subdivisions in industry. More than 1.6 million people work in them. The plant sector is organically linked to industry and, as practice indicates, ensures a significant reduction in the time for development work and the output of new technology.

In many large associations, scientific production complexes which consist of scientific and design subdivisions and production shops operate on the basis of cost-accounting. For example, there are four such complexes in the Leningrad "Svetlana" Association, each of which has a unified leadership and unified services.

Based on experience by the country's leading scientific organizations, intersectorial scientific and technical complexes (MNTK) are being created. Right now, there are 23 MNTKs. This is a new form for linking science and industry, called upon to focus scientific potential on the high-priority directions of scientific and technical progress. However, the establishment of complexes is occurring slowly and with contradictions. The MNTKs, such as USSR Minchermet's "Antikor," USSR Minelektrotekhprom's "Tekhnologicheskiye Lazery," and the USSR Academy of Science's "Personalnyye EVM," have been unable to exit the organizational stage and are delaying the mastery and production of new generations of technology.

Temporary collectives have proven themselves as a form for the accelerated solution of specific scientific and technical problems. The extremely rigid conditions for their operation are stipulated by regulations. No more than 3 years are allowed for fulfilling the entire amount of work. The incentive for completed research is paid only in the event of a successful result. For example, a temporary scientific and technical laboratory at the USSR Academy of Sciences Institute of Radio Engineering and Electronics has created prototype models of devices to raise computer efficiency in only 2.5 years, instead of the 10 years which would previously have been needed to complete this work.

Mediation at the junctures between the individual elements of the "idea-development-application" system has become a qualitatively new form of scientific and technical activity. The idea behind it is to offer organizational and economic assistance in applying innovations and providing engineering, consulting and information services. For example, the Volga Center for Youth Scientific and Technical Creativity, converting to full cost-accounting, concluded contracts for the sum of 800,000 rubles in 1988. The young engineers and scientists took it upon themselves to design an everyday personal computer and to prepare design documentation for modernizing the machine tool equipment and instruments of a Tashkent enterprise.

However, there are many difficulties along this path, related mainly to the scarcity of material and technical resources, and the undeveloped nature of the planning and economic mechanism for the functioning of application organizations. They have no special legal and economic status.

The acceleration of scientific and technical progress is impossible without an interested attitude toward it on the part of associations and enterprises. Under the new economic management conditions, the comprehensive and timely application of the achievements of science and technology is the most important way for them to increase profits. Here, the collectives have been granted greater rights. They must be used skillfully.

New Association Furthers Inventors' Rights

18140141b Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 26 Jan 89 p 1

[Article by N. Kuznetsova: "Union of Protectors"]

[Text] Patent services have existed in our country for more than a quarter century. However, have they always performed their tasks: have they protected the rights of authors and the state to discoveries, inventions, and know-how, and have they developed licensed trade and international cooperation?

Unfortunately, no. Some of the reasons for this are the poor level of patent and legal knowledge on the part of enterprise leaders and development workers, the weakness of the patent services themselves, whose development has followed the remainder principle. This is also understandable: since the economy itself rejected innovation, and since it was unprofitable to introduce even the most valuable inventions, nobody needed strong patent services. This is probably why the profession of patent researcher appeared for the first time in the skills

reference book for specialists of the national economy only a few years ago, and that a patent researcher's wages are noticeably lower than those of a development worker.

Now, the situation is changing. A need for creators has appeared in the economy. Thus, the need to seriously protect their rights is also arising. Most likely, this is why the All-Union Association of Patent Researchers (VAPAT) was formed precisely today, and not earlier. Its founding conference was held in Tallin. More than 100 practical patent researchers, lawyers specializing in protecting industrial property, scientific workers, and VOIR [All-Union Society of Inventors and Rationalizers] representatives from 40 cities throughout the country participated in the conference.

The statutes of this social organization were born through heated debates and conflicts among different points of view.

The association will protect the professional rights and interests of patent researchers, will offer moral and material assistance to its members, will provide decisions about the skills and professional suitability of specialists in the event of arguments, and will also provide consultation for persons interested in solving complex economic problems. VAPAT will disseminate the basics of patent study among enterprise leaders, scientists, and engineers.

The association was formed with the VOIR's support and participation. The VOIR Central Council made the first monetary contribution to its account, and funds will be received from membership dues and economic activity later. VAPAT's plans include creating consulting centers, patent service cooperatives, and application organizations, and coordinating individual labor activity in this area.

S&T Finance Problems Associated With Self-Accountability Described

18140147 Moscow FINANSY SSSR in Russian
No 1, Jan 89 pp 41-44

[Article by G. A. Tsaritsina, doctor of economic sciences, and V. M. Konovalov, department head, TsNIITEstroymash: "Scientific Organizations Under Conditions of Full Cost-Accounting and Self-Financing"]

[Text] As of 1 January 1988, the scientific organizations of the material production ministries converted to full cost-accounting and self-financing. This marks a radical change in their economic position. Now, all of an organization's expenses can only be met at the expense of its own incomes. The state is not responsible for the organization's obligations and does not manage its "content." However, the need for profitable work, proceeding from cost-accounting, gives a real effect to the economy only given the creation of a corresponding mechanism for the economic management of scientific organizations.

Under conditions of full cost-accounting and self-financing, scientific organizations must ensure their own technical, production and social development at the expense of earned funds. They are entirely responsible for the results of their own economic activity and for discharging their obligations to the budget, sector, bank and customer.

At the same time, the recognition of a category, such as "value of scientific and technical production" and conversion of scientific organizations to full cost-accounting, objectively leads to higher prices for research and development work. This price increase should be compensated for by an increasing effect from applying innovations. The practice of conversion has brought to light a number of practical and methodological problems. Conversion is based on a recognition of the commodity nature of scientific and technical production, which offers an opportunity in practice to create a unified system for organizing the activity of associations, and to ensure efficient interactions between associations, enterprises and organizations based on cost-accounting principles, including the use of contract prices coordinated between customer and executor.

The conversion to cost-accounting and recognition of the commodity nature of scientific and technical production requires the revision of a number of important theoretical matters. If an organization's product is a commodity, it should have a value, a use value and a price. Basic research, exploratory development work, as well as specific work of a design or technological nature, could be the product of work by scientific organizations. Different approaches are needed in different cases.

The share of basic research in sectorial scientific organizations is small. It does not yield a direct useful effect, and this is why the expenses for it should be compensated out of the budget. The main point in the work of these organizations is exploratory research and specific development work.

Exploratory research has commodity features, such as value and use value. Scientific organizations have a specific goal in performing exploratory research—the creation of new technology, whose use will make it possible to obtain certain economic benefits in the economy. Therefore, the price of scientific and technical production should depend on the size of this benefit.

Improving the management of scientific organizations is accompanied by expanding the rights and responsibilities of the labor collective, which must solve all problems independently. The results of activity are reflected in the level of the collective's cost-accounting income.

Precisely under the new conditions, plans for scientific and technical activity are being developed primarily on the basis of contracts with customers for creating and delivering new equipment, needed to ensure scientific and technical progress (NTP) in the economy. Naturally, the higher administrative agencies have priority over other customers, yet their orders should not inflict economic harm on the executor. Conversion to contract prices for scientific and technical production does not mean that the need to calculate production cost no longer arises. Cost-accounting would be inconceivable without the commensuration of expenses and results in monetary form. However, under the new conditions, each of the parties in the contract produces a corresponding estimate of the work's value independently. Some experience in drafting mutually acceptable conditions for a contract does exist in the sectors. For example, since 1982 the USSR Minstroydormash has had a practice of concluding protocols for distributing deductions into the economic incentive fund for creating, assimilating and applying new equipment. It seems that there is no fundamental distinction between establishing a contract price for scientific and technical production, under the new conditions, and defining the share of profit belonging to each participant in the creation, assimilation and application of the new equipment for the formation of the economic incentive fund, under the conditions of the previously functioning autonomous system of NTP management.

The establishment of prices for scientific production does not signify a need to settle accounts with the executor completely at the moment the scientific and technical production is implemented. The following variant is also possible: at first, pay back a certain part of the price, refunding expenses, plus a small profit, and then, in proportion to the output of production and the formation of real income on the part of the customer, the

scientific organization receives the remainder of the price. This approach was stipulated, in particular, by a resolution on contracts for creating (transferring) scientific and technical production. The resolution (point 15) states that the parties can stipulate a one-time payment for scientific and technical production in a time period set by them from the day of signing the delivery and acceptance document, or payment for scientific and technical production in the form of payments over coordinated time periods. Advancing money for work also no longer prohibited.

In the present 5-year period, scientific organizations in the overwhelming majority chose (with the agreement of their ministries) the first model of cost-accounting, based on the standard profit distribution. However, there are full grounds for assuming that the second model will become predominant in the 13th 5-year period. The practical implementation of resolutions to improve payment for the labor of scientific employees, designers and technicians in industry guarantees, in principle, favorable conditions for converting scientific organizations to full cost-accounting according to the second model. In the conversion, a great deal depends on the ministries, since precisely they establish the economic standards and must agree to the choice made by subdepartmental associations, enterprises and organizations regarding the cost-accounting model.

It is more convenient for the ministry and for all associations, enterprises and organizations to operate under unified conditions and for identical (in terms of content) norms and indicators to be established for them. Naturally, that model whose features are most similar to the previously existing conditions is preferable. Local economic leaders also favor the first model, since it makes it possible to smooth out the conversion to full cost-accounting and self-financing. For precisely this reason, it has also become widespread.

The basic parameters for economic norms were passed by the ministries in accordance with temporary recommendations on the procedure for converting scientific organizations to full cost-accounting and self-financing, approved by the USSR GKNT [State Committee for Science and Technology], USSR Gosplan, and USSR Minfin, in November 1987. In determining norms for forming cost-accounting funds (funds for scientific and technical and social development, the material incentives fund, and the wage fund) it was decided to proceed mainly from the sizes of the corresponding funds in 1986. Obviously, this is a weak spot in the methodology for converting to full cost-accounting. Practice from the 10th and 11th 5-year periods shows that the formation of economic incentive funds in scientific organizations of the material production sphere was highly unstable. As an example, one could cite data from 1985-1986 for some organizations in the machine building complex (see table).

(in %, 1985—100)

Name of Organization	Material Incentive Fund	Sociocultural Measures and Housing Construction Fund	Development Fund
VNIISMI	83.3	96.9	95.6
VNIIkonditsioner	108.3	107.5	110.3
VPKIlesmash	71.7	56.9	64.3
Giprostrommash	118.6	107.7	—
"Torfmash" GSKTB	71.5	72.3	66.7
"Asbotsemmash" SKB	78.1	62.5	100.0
"Meliormash" TsKB	187.8	178.6	205.7

The change in the sizes of the economic incentive fund is not directly related to the change in the work of the scientific organizations in 1986. For example, the share of production of the highest quality category produced in the development projects of the "Asbotsemmash" SKB [Special Design Bureau] in 1986, increased by six points compared to 1985, but in the development projects of the "Meliormash" TsKB [Central Design Bureau]—by 0.4. The economic effect from applying the finished projects in 1986 grew substantially in the "Asbotsemmash" SKB, but declined somewhat in the "Meliormash" TsKB. The uneven dynamics in the formation and, correspondingly, in the use of incentive resources is generally typical for the spheres of creating and applying new equipment.

One of the serious shortcomings of the autonomous system of NTP management, which has been in effect since 1 January 1988, was a distortion in favor of group and personal interests, to the detriment of the entire collective's interests on the whole. This shortcoming began being eliminated in enterprises even during the large-scale experiment with forming a unified material incentive fund. In scientific organizations, this possibility will appear with the conversion to full cost-accounting and self-financing.

Under the conditions of the autonomous system in the scientific organizations, the lion's share of bonus funds is oriented toward awarding bonuses for finished work. Hence, reduced interest in working to create a scientific and technical surplus and an aspiration to achieve an immediate effect. It seems that this danger exists under the conditions of the new system. To some extent, the labor collective council should act to guarantee prospective interests.

In scientific organizations, interest must be created in conducting exploratory research, including by way of finding an optimal correlation for each organization

between awarding bonuses for specific work and for the results of work over the year. There are no universal recommendations here. The role of centralized NTP management must not be weakened under the new conditions. The conversion of sectors to full cost-accounting and self-financing at this stage leads, it seems to us, to a reduced interest in fundamentally new equipment. As before, scientific organizations are oriented toward achieving present-day economic results, and are still insufficiently concerned about creating a scientific and technical surplus.

Currently, the possibilities for the centralized financing of research and development work on the part of ministry has been significantly reduced. On the one hand, this has caused the sectors to convert in full strength to the new conditions of economic management with a corresponding increase in the role of associations and enterprises, yet on the other, it has led to failure to fulfill many of their planned assignments for 1987 in terms of profit, which could not help but affect the formation of centralized (at the ministry level) resources in the transition period.

In practice the ministries distribute significantly fewer centralized resources, intended for financing the creation of scientific and technical production, than in previous years. As a result, some areas of research and development work are being significantly reduced. Thus, in USSR Minstroydormash the volume of projects of an organizational and methodological nature reduced in 1988 by 37.6 percent, compared to 1987. At the same time, the financing of projects for creating a scientific and technical surplus remained as before and was implemented in a volume, scarcely sufficient for the cardinal acceleration of NTP.

The transition period also reflected on financial work, done on USSR GKNT orders and on those of other centralized agencies (in particular, forecasting subjects). A large quantity of work done on the instructions of centralized departments is financed at the expense of ministry funds. This violates the established procedure, according to which a customer pays money. Moreover, incorrect concepts are created about the cost of much of this work (primarily those, which the scientific organizations of several ministries and departments are working to fulfill). This situation arises because the conversion to full cost-accounting and self-financing was implemented in the absence of an clear definition of the concept of a "state order."

The acceleration of scientific and technical progress is necessary, and enterprises will be forced to seek funding for research and development work, but the demands made of development workers are growing considerably. Enterprises will be interested only in those projects, which will yield a tangible cost-accounting effect and will pay back the expenses with interest. The preservation of remnants of the outlay approach to financing work to create scientific and technical production will not contribute to accelerating NTP and applying the new economic mechanism. Thus, profitability standards are in fact being established (differentiated for each organization) for projects being financed by ministries. In this case, the price does not depend on the degree of effectiveness of the development work. It is set identically both for the most effective, as well as for the ineffective: expenses plus a profit according to the standard set for the organization. The greater the expenses, the higher the price (regardless of effect). Obviously, this procedure needs radical improvement—the price should depend on the use value of the development work, i.e., on its effectiveness.

The question of the structure price for the transfer (circulation) of scientific and technical production has still not been developed. In a number of cases, it will represent a minimum of material and labor outlays (in fact, only according to reduction of copies of drawings and documents), and the rest is profit. It would hardly be proper to distribute a standard for forming a wage fund for such production, although the process of the broad (including intersectorial) and rapid distribution of effective novelties must be encouraged to the utmost.

Conversion to full cost-accounting creates a need to strengthen attention to organizing internal cost-accounting for scientific organizations, which has been insufficiently studied at the present time. In preserving a unified methodological approach to the organization of internal cost-accounting, the individual, specific features of organizations and the nature of their activity, staff and structure are of great significance. Right now, many organizations are actively seeking their own approaches to organizing internal cost-accounting.

The acceleration of scientific and technical progress can only be achieved through the rational combination of centralized management and cost-accounting. In this connection, switching from one extreme to another in the programmatic approach to the management of scientific and technical progress seems unwarranted. With a conversion to the intensive model of economic development, centralized management should increasingly concentrate efforts on the scientific and technical sphere. The task of the centralized agencies under the new conditions is, above all, to establish the priority directions of research and development and to provide financing and cooperation in the implementation of those directions included in the state scientific and technical programs.

Academic, sectorial and other scientific organizations, including cooperatives, should be involved in implementing these programs, preferably on a competitive basis. Insufficient attention is still being paid to developing cooperative forms in organizing scientific research

and development work. Scientific and technical cooperatives are capable of breaking the monopoly position of many sectorial scientific organizations, which would have a positive effect on accelerating scientific and technical progress.

Cooperative forms for organizing scientific and technical activity in the form of so-called "venture" (risk) companies operate successfully in the West, mainly in the United States. The creation of cooperatives for developing and implementing scientific and technical novelties is encouraged, in particular, in Hungary and the Chinese People's Republic. The merits of cooperatives oriented toward scientific and technical progress are obvious. Cooperatives are more dynamic and require relatively few resources. They reduce public risk to a minimum and, in the event of failure, can be easily abolished, but at the same time their success benefits all of society.

Scientific organizations are still only adapting themselves to the changing conditions. Not only the existence of organizations in the future, but also the rates of economic and social development, depend on how rapidly the new economic mechanism will be mastered in the scientific and technical sphere.

Director of New "Innovation Bank" Interviewed

18140169 Moscow IZOBRETATEL I RATSIONALIZATOR in Russian
No 1, Jan 89 pp 4, 5, 7

[Interview with Candidate of Technical Sciences Aleksandr Aleksandrovich Agayan, director of the Leningrad Innovation Bank, and Valeriy Yefimovich Rakhayev, first deputy director and chief engineer of the bank, and with Candidate of Economic Sciences Leonid Aleksandrovich Krot, chairman of the Leningrad Oblast Council of the All-Union Society of Inventors and Efficiency Experts and a member of the Council of the Leningrad Innovation Bank, by the editor in chief of IZOBRETATEL I RATSIONALIZATOR, in Leningrad in September 1988, under the rubric "At a New Stage": "They Are Not Rolling in Money, But Where Are the Ideas?"; first paragraph is IZOBRETATEL I RATSIONALIZATOR introduction]

[Text] Candidate of Technical Sciences Aleksandr Aleksandrovich Agayan, director of the first innovation bank in our country, which has been established in Leningrad, and Valeriy Yefimovich Rakhayev, first deputy director and chief engineer of the bank, granted an interview to the editor in chief of IZOBRETATEL I RATSIONALIZATOR.

[Boxed item: Whoever needs 100,000, write Leningrad. The address is in the text. Inventors! Do you have, in reality, clever inventions? Do not suggest nonsense! This is news: it is tight with ideas! The invention on the scales of commerce: What is its value? The way to the bank is only through the All-Union Society of Inventors and Efficiency Experts!]

Question] Did the bank with such an appealing name for the innovative heart—"innovation"—appear long ago in the USSR?

Oh, no, we are only a month old (the conversation took place in September 1988—editor's note). The general meeting of the shareholder-founders was held on 14 July, on this day the Charter of the bank was approved. But the Chart is not yet a bank, a bank is the opportunity to carry out financing operations. But such an opportunity appeared only on 7 August, when our current account was opened. Thus, if you wish, we have two dates of birth, but no matter from which one you count, we are still very young, we are just getting on our feet.

You said the "meeting of the shareholder-founders." The word "shareholder" is a comparatively new one for our journal, and hardly every reader of IZOBRETATEL I RATSIONALIZATOR is an authority in banking. Could you explain what this means?

This means that there are enterprises and organizations that have, so to speak, extra money. Extra in the sense that it is not entering circulation and lies idle in an account, it happens, for many years. Enterprises for various reasons cannot spent this money—either on their own development or for other purposes. This happens very often, believe us. There are a large number of such enterprises and organizations in our country. So, by giving their money to us, the new bank, enterprises are putting it into circulation, into growth, and become shareholders of the bank.

But what is the point of their doing this? Why do they need the new bank? For the money in an account lies idle only for the given enterprise—but for the state bank this is not dead money, it invests it in the national economy, and owing to this the interest grows, the account increases annually. Every depositor of a savings bank, strictly speaking, knows this perfectly well from his own experience. What is the point of enterprises transferring money from one pocket to another, that is to say, from bank to bank?

It is entirely a matter of interest. The state pays the holders of bank books 2 percent per annum and 3 percent on a time deposit. But do you know how much enterprises receive?

Honestly speaking, no. Is it really not the same amount?

No, not as much—1 percent, half a percent, or else less. The account, indeed, does increase, you stated this correctly, but at what a pace!

Perhaps, the inflationary processes in our country are now occurring far more rapidly.

Just about! The sum at the end of the year has increased, but its purchasing power as compared with January has decreased. This, of course, is unfavorable for enterprises. Money should circulate, otherwise there is economic stagnation.

It is still unclear for what your bank is better for the enterprise than another bank.

For the interest. This is for what. The interest! Not 1 percent and not half a percent—we are counting on 8-10 percent. Our banking has not known such interest.

That is, a minimum of tenfold, or else fifteen- to twenty-fold greater than state banks? This, of course, is appealing.

And how! We now have two depositors—the oblast council of the All-Union Society of Inventors and Efficiency Experts and the technical administration of the Leningrad City Soviet Executive Committee. While 14 are asking to be taken on! And here is what sums they are proposing for the deposit—from 700,000 to 10 million rubles.

I would like to specify—What does "are asking to be taken on" mean? How voluntary, how sincere is this request? Is this voluntary nature not reminiscent of the voluntary nature, with which citizens go to the so-called voluntary people's patrols, to vegetable bases, and to potato fields? After all, the term "voluntary-compulsory" originated under our very eyes, and it is alive, and it has a real basis under it. Is that also not the case here? Did not the oblast party committee or the city soviet executive committee suggest—it says, comrade directors, it is necessary to support the new public undertaking, the Leningrad innovation bank.

Come on! What oblast committee, what city soviet executive committee! For we have explained—the interest, monetary interest. Just who would miss an obvious advantage? No one recommended anything to anyone—the directors themselves understand what is what.

Fine. Let us talk about the goal of the bank. Why was it established?

The goal is to promote the acceleration of scientific and technical progress. An individual inventor or a cooperative or an institute has an effective development. But they have in practice no opportunities to introduce it, for there are no assets, no production base, and no materials. As is known, your knocking will not be hear at enterprises, especially if the development is an intersectorial one. And the first obstacle is that there is no money, there is nothing with which to pay for materials and for labor. A more or less major invention requires for introduction tens, hundreds of thousands of rubles. From where is some plant laboratory, higher educational institution, design bureau, and especially an individual inventor to get them? But we have money, and we can give it—on credit, up to the moment when the invention begins to yield a profit.

To precisely whom can you give money for introduction? I understand—an organization, an enterprise. But the "private trader," the individual inventor—can you give it to him?

Why not? Of course, we can. It would be a worthwhile idea.

For example, 100,000 rubles to an individual inventor?

A half million, if you like! We are ready to give on collateral or the guarantee of an enterprise as much as is required for extensive introduction. But one person cannot assimilate such money and cannot carry out the introduction of his own invention. At least a laboratory or a cooperative or a temporary creative collective is needed. In practice the scheme of actions is as follows. An inventor turns to us—tens of them have already called on us with their ideas. As a rule, they do not have a sound estimate of introduction—they do not know how much materials, what kind and how many people, and what skills are needed, what the production cost of the item will be, what the selling price is.

Of course, they do not know. And they should not know. You demand too much of inventors. He is an inventor, he gave a new idea which the world did not yet know! But you want to demand of him that he would immediately say how many lathe operators of the fifth category and how many grinders of the third category are required for its introduction.

Of course, the inventor cannot be a specialist in all production questions. We are also ready to help him in drawing up an estimate.

This is interesting. Do you not only give money, but also help organizationally?

Within the bank there are four candidates of technical sciences—What does this say to you? We have six experts. They determine how significant, how practicable, and how promising a proposed idea is. The incoming control is exacting, a minor thing will not get through here. If an idea got the go-ahead from experts, we undertake the drawing up of an estimate and its comprehensive analysis, which has been carefully thought out from the financial angle. And it is tight here only with ideas. There were many inventors, but they had few worthy ideas. The majority of them did not bring anything clever.

What—not one idea?

In a whole month we took only one invention. An inventor came with patents of Japan and the United States, with drawings, and with test reports. This is wood wool board, which successfully replaces wood particle board and, in a number of cases, concrete. The bank undertook to study the project, we made a complete analysis, we cannot tell the details, because we value the official and commercial secret. It is sufficient that we are confident of the introduction of the invention and of its great commercial success. Now we are making a schedule of all the operations. A specialized cooperative, which has a recognized guarantor, has been established for introduction. The anticipated demand has been analyzed. We included in the estimate even the expenditures on advertising.

IZOBRETATEL I RATSIONALIZATOR can offer its pages for such a matter.

Thank you, we will consider it.

So, in a whole month is there only one idea for introduction?

But how many should there be? Ten, twenty? We will not overextend ourselves. It is a matter not of the number. In a month we selected only two ideas. And this is all for the present. Inventors did not suggest to us anything more substantial. About 100 people visited us in a month, but, in our opinion, on the economic level their ideas are not worth anything. On the technical level they are often good, they is no denying it—they are original, witty, elegant. But economically they are shallow people.

How can this be?

The anticipated volume of introduction is small. An invention is made at times only for one plant, even for one shop, at times only one, although powerful and unique, yet only one machine is improved. An extra heavy-duty press, for example, or a casting machine. An economic impact is formed at only one plant. It is not this that we need. We need an outlet to the entire country. We are not a charitable society, this must be clearly understood. We are a commercial organization. And if the analysis of an invention, which has been made by us, shows a small demand, we will not undertake its introduction. We will not undertake it, even when the program of assimilation is extremely large—10 million, 20 million rubles. For the present such sums are beyond our capability. We cannot give tens of millions of rubles for 2-3 years. Only the state is capable of this, this is a state program. They came to use with the ideas to extend credit for developments on AIDS. We did not accept. We will not delay—laboratories, test animals, equipment, in case of success the organization of industrial production.... This is beyond our power. We cannot replace the state.

But how much money is now in the bank? Who gave it? This is not a secret, is it?

It is not a secret—we now have 2.5 million. There is 1.5 million from the oblast council of the All-Union Society of Inventors and Efficiency Experts, 1 million from the Technical Administration of the Leningrad City Soviet Executive Committee. For the present we have enough. We have already said—tens of shareholders with their money are asking to be taken on by us. We are for the circulation of assets, but can now attract 50 million rubles, believe us, this is not an exaggeration. But we will not be able to assimilate them—Why do we need them?

In my conception bankers seek a profit everywhere possible.

Perhaps, but one must not forget the goal of the bank: assistance to inventors! Our bank is a special one—an introduction bank. Recently we have a serious temptation—the board of directors of a large Leningrad plant addressed to us the request to lend 500,000 for 10 days at 5 percent. They urgently needed fresh money—for wages, for fixed date payments. Do you imagine the situation? Today you give 500,000—in 10 days without worries, without trouble you have in your account 525,000!

Well, bankers have a life. Did you give it?

No. We would thus lose our character. Our bank was established for new equipment, for inventors, and not to serve as a scapegoat for rotting enterprises. Bear in mind—we would have given the same plant 1 million, and not for 10 days, but for a year, but only for the assimilation of a promising innovation, not for the plugging of holes.

You say you have a group of experts, plus economists, management. How many people are there at the bank?

According to the list of staff there are 32. For the present this is no so, now there are only 20 people.

If it is not a secret, what is the wage of modern bankers?

For the director it is 450, for the deputy director it is 350. For the others it is accordingly. This is now. We hope for more. The wage now comes from the fund, which has been allocated for the activity of the bank, for premises, equipment, evaluation. By the end of the year (1988—editor's note) we are confident that we will completely recover the expenses for wages, equipment, and so forth. As of January 1989 we are switching to the second model of cost accounting and will rid ourselves of staff salaries. We will receive subject to the efficiency of our activity.

And how do you intend to settle accounts with the authors of introduced proposals?

We will certainly not stint. The maximum reward for an invention, which is established by legislation, is 20,000 rubles. This maximum seems to us like the minimum. It is necessary to pay well for a good idea. We believe that

the author should receive a specific percentage of the profit all the time while his invention is used, his entire life, if you like. And if not his entire life, then about 15 years without fail. In the labor agreement it is possible to envisage different versions which are convenient for the author of the idea.

The bank now exists chiefly on assets of the All-Union Society of Inventors and Efficiency Experts, at least the basic deposit is ours, that of the All-Union Society of Inventors and Efficiency Experts. Do you give any preference to innovators who are members of the All-Union Society of Inventors and Efficiency Experts, or is it all the same to you who comes to you?

How "is it all the same"? It is not all the same. Of course, preference goes to members of the All-Union Society of Inventors and Efficiency Experts, and more than that, we conclude and will conclude labor agreements only with members of the All-Union Society of Inventors and Efficiency Experts. Anyone can come to us, but we will extend credit only for those proposals which have been recommended by organizations of the All-Union Society of Inventors and Efficiency Experts of any level, except primary organizations. Note this without fail: the way to us lies only through the All-Union Society of Inventors and Efficiency Experts. But this is at the second stage, when an idea is accepted for introduction, while at the initial stage, when we are evaluating the commercial significance of a proposal, recommendations are not needed.

The bank is a Leningrad bank, but does it deal only with Leningraders?

No. We are willing to help any innovator, no matter where he lives. It seems absurd to us to limit introduction to the framework of the residence registration of the inventor. So go and write: let inventors send us their technical solutions from the entire country. We will examine everything that we receive. We warn: we guarantee introduction to far from everyone. In the Charter of the bank it is clearly stated that the bank will introduce only highly profitable inventions and innovations. Highly profitable! We will not get involved with others. For this reason we do not need only descriptions of the inventor's certificates and the promising, but unintelligible advertising text. We will give preference to economic calculations. There should be a convincing technical and economic analysis of what will be offered us. If only an approximate analysis, but the inventor or collective of inventors should take into account that the higher the level of this analysis is, the greater the chances are that we will undertake to extend credit for the invention. Moreover, this should not necessarily be an invention and not necessarily an efficiency proposal—we will consider any technical idea. It is also possible and necessary to send refused, unregistered, rejected, and forgotten ideas and other ideas that are out of favor. If an idea interests us, our bank is at the service of the innovator. We will allocate money, as much as is required, will find an enterprise, will seek materials, including centrally allocated materials. Associations, enterprises, organizations, cooperatives, individual inventors...can make an appeal.

Well, for our readers this is a challenge, and even a daring one. Do you understand what a barrage of proposals you are calling down on yourselves? The readers of IZOBRETATEL I RATSIONALIZATOR are special people, they do not overlook such appeals. Are you not afraid that they will flood you with ideas?

Come on—"afraid"! We would be happy. We are seeking clever ideas, now it is they that we need! But if you are afraid of inventors, do not go to the innovation bank.

At what address can one write you?

191011, Leningrad, Nevskiy Prospect, 32/34, the Leningrad Innovation Bank.

Thus, the first innovation bank in the country has begun to operate, and its basic depositor is the All-Union Society of Inventors and Efficiency Experts. The fact is significant one, which opens a new business page in the activity of our Society. It was impossible not to turn in this regard to Leonid Aleksandrovich Krot—chairman of the Leningrad Oblast Council of the All-Union Society of Inventors and Efficiency Experts, a candidate of economic sciences, and a member of the Council of the Leningrad Innovation Bank.

Leonid Aleksandrovich, I have many questions for you. What is the All-Union Society of Inventors and Efficiency Experts seeking in the new type of activity? From where did the oblast council get 1.5 million? What do you think about the fact that the bank intends to introduce "non-Leningrad" inventions and, perhaps, outside Leningrad? How do you intend to treat the interest, the profit, which, we will hope, will begin accrue to the deposit of the All-Union Society of Inventors and Efficiency Experts? And so on and so forth.

What is appealing to the oblast council of the All-Union Society of Inventors and Efficiency Experts in the activity of the bank? Of course, assistance to introduction. What a hard time we, a public organization, had with this question! We helped the innovator as we could, but we did not have either money, I have in mind large sums, or equipment, and it is not surprising that the inventor often left us dissatisfied. Now it is a different matter. The bank is one of the practicable means in the implementation of innovations. You will not introduce much without credits. Things were especially bad with individual authors, with "people working at home." But significant ideas are encountered among them. And the clubs of amateur creative technical work? They are also hard pressed for assets. At one Leningrad club they are developing an engine for a dirigible, for a balloon, and are earnestly dreaming of building a dirigible. Of course, they will not manage without financial assistance. We

are thinking of helping. We have money—from the assets of the Central Council of the All-Union Society of Inventors and Efficiency Experts, the All-Union Central Council of Trade Unions allocated them specially to aid introduction (see IZOBRETATEL I RATSIONALIZATOR, No 8, 1988, p 2—editor's note). We are hoping for the steady growth of the deposit due to the interest, it is, after all, high—up to 10 percent, for us this is 150,000 a year. It is not mandatory to take it and spend it, let the sum increase—inventors are not worse because of this. But we can also take it and spend it on something—we will act according to the circumstances, it is now too early to speak about this. That the bank intends to work for the entire Union, is not zeal. On the contrary, let everyone know that Leningrad is ready to help not only its own oblast, but also the entire country. In the future we also plan to have at the bank currency, again for our introduction needs. They have already appealed to our bank from Sweden—they want to deal precisely with us, with the innovation bank, with a joint stock bank. Our bank has greater freedom than the state bank, there they have instructions and decrees and consultation with Moscow. But our bank council voted, and money is being given, there is no bureaucracy. The bank with time, I am confident, will grow, for the attraction of money for introduction we also intend to issue shares, let everyone who wishes participate with his ruble in introduction, let everyone derive a real, appreciable annual profit from the activity of innovators. We will give an announcement on the issuing of shares in IZOBRETATEL I RATSIONALIZATOR, without fail. For the present we will not hurry—it is necessary to get moving the money that is available and to put it into circulation, so that it would work for new equipment. Such banks, I believe, are what the All-Union Society of Inventors and Efficiency Experts needs, they will probably multiply, they have already called me in this regard from Estonia and Azerbaijan, have come from the Ukraine. The All-Union Society of Inventors and Efficiency Experts is now at a new stage, and we are hoping for success.

From the Charter of the Leningrad Innovation Bank

The basic tasks of the bank are:

— active influencing of the acceleration of scientific and technical progress,

— the development and stimulation of the initiative of collectives and individual citizens in the development and introduction of inventions and innovations,

— the gathering and analysis of supply and demand in the sphere of innovation activity,

— the efficient use of credit resources.

The minimum amount of the deposit in the authorized capital stock of the bank is 100,000 rubles.

The bank operates on the basis of full cost accounting and self-financing and has its own balance sheet.

The bank can, if necessary, open its own branches in Leningrad, in other cities of the USSR, and abroad.

Banks, departments of the All-Union Society of Inventors and Efficiency Experts, scientific and engineering societies, ministries, departments, associations, enterprises, organizations, and cooperatives, which are juridical persons, can be shareholders of the bank.

The bank carries out the crediting and financing of expenditures, which are connected with innovations and their introduction in production; with the introduction of inventions and highly effective efficiency proposals. The bank carries out the acquisition of scientific and technical developments from associations, enterprises, organizations, cooperatives, and individual citizens for the organization of the production and marketing of new equipment and technology. The bank carries out consultation services, the organization of scientific, technical, and patent examination, and technical and economic evaluations.

The bank can take part in the establishment of joint works and in measures on the development and introduction of inventions and innovations.

The bank can conclude contracts (agreements) with foreign and international banks for the purpose of conducting operations on the crediting and financing of the innovation activity of associations, enterprises, organizations, cooperatives, and individual citizens, which is connected with currency resources for export-import operations.

Director of Physical Technical Institute Interviewed on Physics Research

18410135 Moscow PRIRODA in Russian
11 Nov 88 pp 4-11

[Interview with Zhores Ivanovich Alferov, director, Physical Technical Institute imeni A. F. Ioffe, by I. N. Artyunyan, staff correspondent, date and place not given: "The Cradle of Soviet Physics: An Interview with Zh. I. Alferov"]

[Text] **On September 23, 1918 at the 38th session of the Malaya Oblast (Petrograd) Commission on Education, it was decided on the basis of A. V. Lunacharskiy's paper "On the State Roentgenology and Radiology Institute" to develop a plan of activity for the Physical Technical Department of this Institute. A. F. Ioffe was delegated to develop this plan. The USSR Academy of Sciences' Physical Technical Institute imeni A. F. Ioffe starts its chronology from that date.**

Our correspondent I. N. Artyunyan met with the Institute's director, Zh. I. Alferov. The conversation, which began with "Fiztekh's" history, its role in the founding of physics in the USSR, and todays tasks and problems, also covered a wider range of issues in the organization of science, the training of scientific personnel, and the interaction of scientists and industry.

The editors and the editorial board of "Priroda" congratulate Fiztekh's entire staff on their anniversary and wish them further fruitful efforts.

PRIRODA: Zhores Ivanovich, an anniversary is a good time to look back, to critically assess successes, and to better understand today's problems. While preparing to meet with you, I familiarized myself with the history of the Physical-Technical Institute, and the first thing that shocked me was the abundance of outstanding scientists who have come from it. One gets the impression that in one way or another all of Soviet physics came from this "cradle."

Alferov: Indeed, it has often been noted on our anniversaries that the Physical Technical Institute imeni A. F. Ioffe is the alma mater of our country's physicists. I think that this is a generally recognized fact. From the very beginning of its existence, Fiztekh has developed the most promising areas of modern physics, many of which later became decisive to scientific-technical progress. It is no accident that the name of the institute, which was never changed in the initial stage, has always included the phrase "physical technical." Even in those years long ago the founder of our institute, Abram Fedorovich Ioffe, understood fully that physics is the foundation for the development of engineering and technology. We don't always recognize this now, but, I submit, thispposition was even more significant then. In 1936, at the Martov Sessions of the Academy of Sciences, our institute and its director A. F. Ioffe were sharply criticized for research which had no obvious results for practice, primarily for work on the atomic nucleus begun at the institute in the 30s. But sooner or later history adds the right accents. When, as they say, the thunder rumbled, Fiztekh was ready. It so happened that scientists who had graduated Fiztekh, who had come from its school, I. V. Kurchatov, A. P. Aleksandrov, L. A. Artsimovich, Ya. B. Zeldovich, I. K. Kikoin, N. N. Semenov, Yu. B. Khariton—I can't list them all—made a fundamental contribution to the solution to the atomic problem. If my memory serves me right, 41 active members of the USSR Academy of Sciences, 15 academicians of the union republic academies, 23 corresponding members of the USSR Academy of Sciences, and a multitude of Lenin and USSR State Prize winners are alumni of Fiztekh. Four of our former associates, I. V. Kurchatov, A. P. Aleksandrov, Ya. B. Zeldovich, and Yu. B. Khariton, have been named Heroes of Socialist Labor three times(!).

Our scientists have created scientific schools and organized new institutes. During its existence, Fiztekh has "given birth" to about 20 major scientific organizations. Our "first born" are the Kharkov Physical Technical Institute, the Institute for the Physics of Metals in Sverdlovsk, the physical technical institutes in Tomsk and Dnepropetrovsk, and the Institute for Chemical Physics. In the area of nuclear research, as I mentioned, three whole institutes emerged from the Fiztekh's womb: the Institute for Atomic Energy imeni I. V. Kurchatova, the Institute of Theoretical and Experimental Physics in Moscow, and, not that long ago, the Institute for Nuclear Physics in Gatchino. Our "youngest child" is the Institute for Computerized Information Processing in Leningrad, formed from our institute's computer center.

So in speaking of Fiztekh's role in the evolution of Soviet science, one might identify three aspects: staff training, the creation of new research organizations, and the idea of considering a fundamental science, physics, as the basis for scientific-technical progress. And of course in practical terms, our specific results.

PRIRODA: I understand that it's impossible to describe all the research going on at Fiztekh in detail, so I want to ask you to dwell on a field close to your scientific interests, the physics of semiconductors. One is often forced to encounter the garish journalistic term "silicon age." In your opinion is this the present or the coming age? What tasks confronting semiconductor physics?

Alferov: About half the staff of our institute is employed in this field of knowledge. I think that we were engaged in systematic research of semiconductors before anyone else in the world, since this area is a tradition for us. Besides, efforts have been concentrated precisely in this scientific field as a result of the "gemmation" of institutes, the challenge to our basic staff to solve the atomic problem of which I spoke earlier.

I must say that in the early postwar years these processes put Fiztekh in a rather serious position: Its strongest associates left, and thepinstitute had to be almost recreated from scratch. The greatest scientific event of our

times occurred then: the creation of transistors, which for many years defined one of the major areas of physicists' work. To study the physics of semiconductors Fiztekh began to gather a young work force, research picked up, and it is now a major center in this field in our country. I mean both the number of people employed and, I hope, the quality of the results.

So, Fiztekh is the origin of the so-called A=3B=5 semiconductors, compounds of groups III and V in the periodic table. As early as 1950 our associates N. A. Goryunova and A. R. Regel studied the properties of one of these compounds for the first time in the world. Their results were presented at a conference in Kiev, and two years later they were published in "Izvestiya AN SSSR" as the materials of this conference. A few months later, an article by West Germany's Welcher, who admittedly synthesized many compounds like A=3B=5, appeared, but this was two years after our scientists. Unfortunately, we did not promote our achievements well enough on the international scale. At that time Soviet journals were not translated in the West, international ties were very weak, and as a result even semiconductor specialists knew little about these works. In principle, of course, they were known, and for this reason Welcher was denied patents in England and in other countries. But nevertheless, this was already a struggle for priority ex post facto, which is something else again. When I received the Welcher medal, he said that it should be called the Welcher-Regel-Goryunova medal.

But you asked about silicon. I don't think that it will be displaced by other semiconductors in the future. I would compare silicon to iron in metallurgy. Iron is the basis of the large-scale use of metals, but one can't do without nonferrous metals. The fact is that the basic problem in semiconductor technology is to increase element density on the wafer. Today we have mastered micron technology, tomorrow we are preparing to move on to submicron. The rate at which information is processed, the problem of developing high-speed computer components, has become decisive role. The development of super-fast components on the basis of A=3B=5 compounds, primarily their heterostructures is more promising for several reasons. A=3B=5 type compounds—gallium arsenide and others—are the most suitable materials for developing optical communications, which are impossible with silicon. These heterostructures make it possible to combine both optical and electronic components in one integrated circuit. I submit that this is the main road to the development of high-speed electronics.

On the other hand, heterostructures, which we were also first in the world to research, permit highly precise study of the quantum properties of solid bodies. The crystal lattice of a solid body is described by the average distance between its atoms. Thanks to the development of ultra-fine technology, the active area of semiconductor instruments has already reached the size of several such distances. We developed the fundamental ideas of the physics of semiconductor heterostructures in the early 60s and became pioneers in this field. Now the so-called wave-function engineering has emerged from it. We can alter the chemical composition of compounds, constructing very accurate objects, as they say, atom by atom. We can create artificial miniature traps for particles in a solid body, so-called quantum potential wells, and thereby studying a multitude of interesting phenomena. For practicalppurposes, this has produced high-speed transistors, lasers, and other electronic instruments. This is one of the basic directions of Fiztekh's work, which also includes the development of prototypes for future devices.

Our interests in the field of solid state physics have never been limited only to the physics of semiconductors, but we have now begun to research another area not quite as traditional for us. I mean high-temperature superconductivity. Before, it was primarily theoreticians who studied superconductivity here. A couple of experimental groups studied superconductivity in semiconductors. Now it is even hard for me to say how many laboratories are involved it this. Under the national high-temperature superconductivity program, Fiztekh has been assigned the role of the scientific center for superconductive electronics.

Tremendous success has been achieved in the physics of superconductivity: Materials in which the transition to the superconductive state is above the boiling point of nitrogen have been produced. The advantages are tremendous! But it is impossible to transfer them immediately to superconductor electronics, which operate at helium temperatures; certain advantages are simply lost in the transition to liquid nitrogen. We are dealing with new materials, whose behavior we are only beginning to study. For example, we don't know what processes take place when metals and semiconductors come into contact with a high-temperature superconductor. But this is very important for electronics. In general, a lot of work lies ahead. There is reason to hope that high-temperature super-conductivity will help solve the problem of increasing the rate at which information is transmitted in microcircuits. But I personally believe that the major applications of this phenomenon in electronics are still unknown to us.

Nevertheless, despite a pronounced leaning toward semiconductors, Fiztekh can quite justifiably be classified as a multidisciplinary institute, just as it was in previous years. Solar physics, gamma astronomy, plasma physics, the physics of strength, theoretical physics, computer methods and modeling.

It is simply physically impossible for me to even remember all the scientific interests of our associates.

PRIRODA: The breadth of the subjects of research is always impressive. But isn't there a dark side? Which in your view is preferable, these "monster institutes" with a

huge staff of associates and diverse research, or small single-discipline organizations? Where is the optimum after which an institute may reach "critical mass" and spontaneously collapse.

Alferov: Indeed, the question is not a simple one. Managing a large institute is a difficult matter. I can say that with full knowledge of the situation. In fact, specialized institutes not too large in scale are becoming increasingly important. But large scientific centers do and apparently will continue to exist. These are organizations with deep traditions, a very rich history, and a very strong scientific staff. Judge for yourself: Today Fiztekh numbers more than 3,000 associates, a good half of which are scientific associates, including about 200 doctors and 700 candidates in science. Our scientists can obtain qualified consulting in almost any area of physics without leaving the institute. In and of itself this collective already represents a great treasure, and to break it up or dismember it would bepshort-sighted. As is generally the case in science, a healthy conservatism fits in here. Ultimately, new scientific fields develop not by government decree, but as a result of scientists' work. The task of the scientific organizational superstructure is not to interfere, but to support and provide the appropriate scale to the most promising directions in research. This is most often possible at major science centers, since many discoveries have been made at the juncture of the related scientific disciplines in whose development different parts of institutes like ours are engaged.

As regards the dark side of major scientific institutes, even those that are well and reliably run, the problem is primarily this. Science has become much a more expensive and complicated enterprise than it was 20-25 ago. In those years, if a person got a good idea and he merely worked in a good scientific institution, he could usually implement it before anyone else by assembling homemade devices and getting results. Today, when a powerful scientific instrument industry has developed all over the world, this approach will in most instances results in lost time. I don't mean those situations, which are not rare in modern research, when one cannot do without incredibly complicated and expensive instruments.

To be brief, good modern science requires complicated instrumentation, subtle and excellent diagnostic methods, technologies for producing experimental prototypes, and finally, powerful computer equipment to automate an experiment and process data. The development of modern research tools is the number one problem for natural science research in our country. And it is extraordinarily difficult to solve this problem in a multidisciplinary institute, to develop favorable conditions for everyone. Here too one cannot do without cooperation, not only scientific, but also organizational. Until now major institutes have been feudal laboratory-kingdoms, and this decentralization was up to a point even a positive factor. Laboratories solved their own problems, and scientific cooperation existed on the level of seminars and discussions, but no more. Now the development of modern experimental tools is beyond the capabilities of even the strongest institute laboratories. They have to be developed for groups of laboratories which work in a specialized area within an institute and strengthen research in the most promising fields.

PRIRODA: Who decides this, and how? It is no secret that many things in science depends on the managers' abilities to cut red tape, on their personnel connections and prestige. And along with this, the fact that prediction in science is often a thankless task. You yourself said that "science is strong because of its unpredictability."

Alferov: The head's name will always work, and this should not be taken in the negative sense. It reflects not only his own scientific work, but also the prestige of the institution he directs. Unfortunately, the influence of a well-known scientific name has sometimes been exaggerated, and scientific honors earned too long ago still pay dividends. There is one solution here: open discussion of topics and selection of the priority areas of development on the basis of competition. We even have such experience in the Academy of Sciences, in research on high-temperature superconductivity. Recently we used closed expert examination, secret balloting, to determine the best works in this field and allocated funds on the basis of the results ofpcompetition. We are now trying to introduce a similar system of internal competition here at Fiztekh. This approach makes it possible to avoid protectionism, the pressure of big names and prestigious organizations. However, this system does need further development and refinement. We still have to learn democracy, step by step, without substituting any organizational innovations. For example, the Academy of Sciences has a splendid system for electing directors of institutes in the branches, and I think it must be retained. Moreover, even in industry the election of directors by labor collectives is not as simple as one might think. But since we began to talk about these things, I will say that science needs glasnost and openness and needs them on an ever growing scale. Let me explain what I mean. In science there is excessive and rarely justifiable secretiveness. This is the heritage of the "cold war" and all the closed projects. And when I say "glasnost" in science, I mean also minimizing the number of closed and secret projects, except of course, when they are of real significance to defense.

There is no secret in the fact that a whole series of publications, dissertations, etc. with the stamp "for official use" and with even more serious stamps conceal one thing: the low level of those works and the incompetence of their authors.

PRIRODA: Zhores Ivanovich, it's of course very important that basic lack of professionalism not be hidden behind the wall of secretiveness. But good institutes probably don't have such phenomena. What's keeping

the scientists in these institutes from obtaining world-class results? You talked about Fiztekh's successes, but it's no secret that many scientific discoveries in recent years have not been made in our country. What, in your opinion, are the problems with Soviet scientists' work?

Alferov: To put it simply, our horrifying poverty. I talked about our work on semiconductor heterostructures. We studied the unique features and physical properties of this materials brilliantly, but we aren't capable of creating integrated circuits from them and often aren't capable of performing the technological experiment required from the standpoint of physics on a sufficiently high level. We need ultra-high-resolution electron microscopes, the latest advances in Auger spectroscopy, molecular epitaxy setups, and finally ultra-clean areas, so-called "clean rooms." We literally lay one atom on top of another, preparing our specimens, and an error in a few permanent lattices is considered very grave. The instruments I mean are very expensive; research demands multi-million-ruble investments. And basic science lives on a very skimpy financial ration. Furthermore, our country is very far behind in the development of scientific instrument building. We did not create the appropriate industry in time, but counted on equipping institutes out of our own resources. But this was beyond the means of even giants such as ours. Now, admittedly, the USSR Academy of Sciences' Inter-Branch Scientific-Technical Complex for Scientific Instrument Building has been created to solve this problem. But this is a new matter, and we're just beginning to receive the first micro-result.

PRIRODA: In other words, industrial development doesn't satisfy scientists' demands, slows the evolution of science, and this in turn keeps industry, which uses science's achievements, from developing? Itspa vicious circle. How should science and industry cooperate to their mutual benefit?

Alferov: For some reason we're accustomed to hoping that some new organizational structure will solve our problems of scientific-technical progress and the rapid introduction of science's achievements in industry. My personal opinion is that all this is purely an economic matter. The changes taking place in our society are aimed at solving this problem. How to stimulate industry so that it quickly and willingly introduces science's achievements—this is a question for economists. I submit that the now widely discussed system of complete cost accounting and specific elements of market economics must play their role. Of course, I'm talking about cost-accounting in industry, and in no way in science. Science is financed and must be financed from the state budget. Under cost-accounting, industry will be interested in getting results from us.

I have to say that Fiztekh has given industry quite a lot since the war. Almost the country's entire semiconductor industry was to a great extent created by our institute's developments. The first Soviet transistor, the first power rectifiers, thyristors. Fiztekh created modern semiconductor laser technology—heterostructure lasers. There was a time when we even led the USA in commercial production of these lasers. Now the rate of development in this field has begun to slow very seriously, and it's not just a matter of the period of stagnation, although it did have an effect. The monopolistic system of lead institutes and institutions or, more generally, the administrative command system, has been activated. I can cite a multitude of examples when we establish direct contacts with an electronics company and train its people, and they begin to do something. Then the matter moves to large-scale business, and suddenly it turns out that this company is not registered in the ministry's "apportionment," and in their opinion our business should be done by an entirely different organization. But this organization has other rows to hoe, it feels that our business can wait, and it does. There is a multitude of variations on this theme.

As I already said, the problem of interaction between science and industry belongs purely to the economic sphere. But it has another aspect directly related to the development of science. The relations academic institutes have with industry today resemble a one-way street. Science gives production not only new ideas, but sometimes even a fundamentally new technology. But there's almost no reverse flow, in the form of material incentives. What did Fiztekh get for development that semiconductor technology? Or for solar batteries? Or for the metallurgical process monitoring system developed on the basis of our mass-spectrometers? Nothing! We transferred technology to industry, our associates sat there without recourse and only.

Much rests also on the existing system of authors' certificates. If some improvement is proposed to an existing device, the bookkeeper can calculate the economic effect, on the basis of which a sizeable bonus is paid. But if you propose a new type of laser, a new solar battery, anything so new that it has no counterparts, then the situation changes. Yes, the originators of the novelty are recognized with the highest awards. Of course, you saw a multitude of portraits in Fiztekh's corridors. These are our laureates: 28 associates awarded the Lenin Prize; 92, the USSR State Prize; 21, the Lenin Komsomol Prize! This is how the government rewarded their scientific achievements, but we got nothing frompindustry. The appearance of a novelty results in direct expenses: People have to be trained, the production process altered. As a consequence, plants appear, a new branch of industry is created which produces goods and must earn profit. But we, the "trigger" remain on the sidelines. But we also need funds to conduct extensive research, for example, in parallel areas to maintain our primacy. As a result, it turns out that even if we're the first to say "a," we then begin to fall behind.

Let me repeat, academic science must be financed from the state budget, but if scientists come under cost-accounting and their ideas become commodities, they

must get a proper price. There must be a mechanism for paying a portion of industry's profits to science. Therefore, we have created a department for economically promising research at the institute.

PRIRODA: As G. I. Marchuk said in a speech to the 19th Party Conference, the tragedy of our sciences is not just that links between science and the national economy have been broken. He recalled another broken link—between science and education. How are Fiztekh scientists taking care of their own successors, of educating young scientific personnel?

Alferov: This is the next critical group of problems which we are seriously studying. We've had some difficulties and some successes. Again we need to look to history. A. F. Ioffe was unquestionably one of the most brilliant organizers in science. At the beginning of the century he understood that physics is the basis of engineering and technology and then came to the conclusion that physicists would need an education different from the traditional university education. In 1919, in the heat of the civil war, the Polytechnical Institute's Physical Mechanical Faculty was created. It embodied Abram Fedorovich's idea of combining the basic university education with a specific engineering education. In his opinion, the physicist had to know how to solve purely engineering problems, while the research engineer had to know physics well. The symbiosis of Fiztekh and "Fizmekh" was very productive. Several renowned scientists whom I mentioned at the beginning of our conversation were alumni of Fizmekh. But then in 1955 N. S. Khrushchev, who as we know did many good things, prohibited dual appointments. This naturally made teachers employed in scientific institutions leave. It's true that some of Fiztekh's scientists remained to teach unpaid. These were basically our director at the time, B. P. Konstantinov, Professor D. N. Nasledov, and G. A. Grinberg, corresponding member of the USSR Academy of Sciences, an associate of our institute since 1919, and the first graduate of the Physical Mechanical Faculty, who still works at Fiztekh! They understood that the reform would harm education and ultimately science. But that's life, and many scientists left teaching. After a certain time those delicate links which we're now discussing were broken too. When dual appointments were again permitted, all the vacancies turned out to be filled. It is always difficult to restore something, and we undertook to create basic departments. First, of course, we turned to Leningrad Polytechnical Institute, but then the dean, as they say, wouldn't let us in the door. The same thing happened at the university. There were no vacancies, and no one needed the applicants. My old comrade, A. A.pVavilov, dean of the Electrical Engineering Institute imeni V. I. Ulyanova (Lenina) completely understood everything and immediately hired us. This is how the Fiztekh's first base department was created, and it has existed for 15 years. Later such departments appeared at the Polytechnical Institute as well. Our laureates already include alumni of these departments. This year we created a tenth new department at the Polytechnical Institute, the Physical Technical Faculty of LPI [Leningrad Polytechnical Institute]. This faculty should become our Leningrad "Fiztekh."

PRIRODA: You mean like the Moscow Physical Technical Institute?

Alferov: In general yes, but a little different. By the way, the idea of a physical technical institute, i.e., a system of individual instruction and interaction with major research centers, migrated to Moscow with our Fiztekh people. The organizers of the Moscow Physical Technical Institute were P. L. Kalits, N. N. Semenov, and other alumni of the Leningrad Fiztekh. Over the 40 years of its existence in Moscow, this system produced outstanding results. And in Leningrad? Many bright young men went to study at MFTI [Moscow Physical Technical Institute] and sometimes did not return to Leningrad.

Now MFTI has also become a unique "monster" by your definition, with a large number of faculties and a huge staff of professors. But many great scientists are only listed there; students never set eyes on them. We also want great scientists to actually work with the students of LPI's physical technical faculties. Direct interaction with the people doing modern scientific research is extremely important for the development of future scientific personnel. In the 20s and 30s, Fiztekh was the Academician Ioffe's "kindergarten," and this tradition has been continued. We're planning to train specialists not just for our institute, but for branch NII [scientific research institutes], primarily in Leningrad, but also in other cities. Future research engineers will have the opportunity to do internships and graduate studies here at Fiztekh, thereby increasing its temporary staff while keeping its permanent staff of associates. Industry must have more people educated in advanced scientific ideology. This is more important than introducing a particular laser. Today a certain number of people who have gone through this school of advanced scientific disciplines are working in industry institutes. When there gets to be a lot of them, this will be our most valuable contribution. I must say that the Leningrad Party organization welcomes this undertaking, and the CPSU's Leningrad obkom immediately supported it.

PRIRODA: Zhores Ivanovich, since we've started talking about higher education, it would be difficult to avoid the painful subject of the forced interruption of education due to the practice of drafting students into the army after their first or second year. What's your attitude toward this?

Alferov: This situation has existed for a long time, and, if we look at the demographics, it will continue for some time. Admittedly, 13 vuzes in the country have gotten legal exemptions from the draft to continue education. These are vuzes of a specific type—in Leningrad, the Shipbuilding and Mechanical Institutes and the Institute of Precise Mechanics and Optics.

In my opinion, the country's science and, paradoxical as it might seem, its defense have suffered and are suffering from this. The most irrational of all possible decisions was made as a result of poorly planned and short-sighted attempts to compensate for the demographics curve. Finally, we knew about the demographic curve beforehand. If the army cannot in fact get along without students, then it would be better to set up 11 years of elementary and secondary education and give students Saturdays off. Then they could be drafted after school, but before beginning instruction in vuzes, without interrupting the latter for 2 or 3 years. Many countries have mandatory draft: In some they serve immediately after high school, in others just the opposite, after they have completed their higher education. In Finland, I believe, the regulations are that one must serve one's tour of duty in the army between the ages of 18 and 27, but the time of service is at one's own discretion. But I've never heard of interrupting education. To be brief, you can't imagine anything worse. The young men who return are different, and their education must start all over again.

I remember an article in "Literaturnaya gazeta," in which Gen. M. Gareyev presented the most diverse arguments in favor of army service, particularly that future scientists would mature there, etc. I'd like to suggest a simple thing to him. Let cadets at military colleges and students at military academies be sent to construction projects or to harvest vegetables or cotton after their first year of education. They'll also come back mature, strengthened in the fresh air, and with a knowledge of national economic problems. But what can one say about the training of these military specialists? I think that Gen. Gareyev and many his colleagues would protest such a decision, and they would be right.

PRIRODA: One would hope that the deciding role of science in the development and renewal of our society will be recognized not only in words, but also in deeds among the most diverse groups—government, economic administration, military.

I, as a representative of a natural science magazine, am especially concerned that society properly understand the goals and tasks of basic science.

The usefulness of applied research is obvious, but the importance of basic work to learn the laws of nature must often be proved.

Alferov: Indeed, no one argues the importance of applied work, since it is by its very nature done in response to particular demands of society. Let me give an example, once again from Fiztekh's history, when a group of scientists under A. P. Aleksandrov began even before the war to work on demagnetization of ships. Not one ship equipped with the so-called LFTI system was destroyed by magnetic mines. This typical applied work saved the lives of tens of thousands of Soviet seamen. Another example is work on pulse radar, also begun before the war by D. A. Rozhanskiy and continued by Yu. B. Kobzarev and his associates.

But basically Fiztekh is engaged in basic research, which doesn't necessarily produce new devices or new technology. For example, before the war the basic semiconductor was cuprous oxide. Research was done on this compound, and as a result basically many phenomena of semiconductor physics were studied. But silicon and germanium became the real semiconductors for commercial application. Does this mean that the experiments on cuprous oxide were unnecessary? Of course not. Thepfoundations of semiconductor physics were laid: From cuprous oxide we learned about zone structure, photoconductivity, and many other things. If there had been no basic research in areas such as, for example, the physics of semiconductors or the atomic nucleus, there wouldn't have been many of the applications without which our everyday life would be impossible. Almost all the creations of the human hand around us originated from the knowledge and understanding of nature.

However, the role of basic research is not just possible future applications. Ultimately there might not be any: Not all new physical phenomena find an outlet in practice. Basic research elevates the overall cultural level of society and its intellectual potential. The high level of basic research in a country is at the same time always the highest level of a society's development. This is seen when problems remote from physics are being solved, let's say in economics and politics. Our society must be built on scientific principles, and if this is so, then science's primacy must be ensured. Therefore, like many other scientists, I was of course glad that M. S. Gorbachev's speech at the 19th Party Conference gave science and its role their due.

Pay Bonuses to Scientists Recommended

18280059z Moscow SOTSIALISTICHESKIY TRUD in Russian No 11, Nov 88 pp 29-32

["Labor Scientific Research Institute Recommendations on Awarding Bonuses to Workers in Scientific Organizations"—SOTSIALISTICHESKIY TRUD headline]

[Text]

1. The present recommendations have as their goal the improving of the awarding of bonuses to workers in scientific organizations when they shift to complete cost accounting and self-financing.

In this regard, the awarding of bonuses should guarantee the workers' interest in achieving and outstripping the world level in scientific and technological development; increasing the labor effectiveness of scientists, designers, industrial engineers, and other specialists; strengthening the ties of science with production; and satisfying the needs of consumers for new equipment and technologies in every possible way.

2. The organization independently develops a Statute on Awarding Bonuses to Scientific Workers, Specialists, Employees, and Workers. It determines the amounts of and procedure for awarding bonuses based on the requirements for accelerating scientific and technical progress, increasing the scientific level of research, raising the effectiveness of solutions, and strengthening the creative activity and work results of scientific workers, designers, industrial engineers, and other specialists.

The director of the scientific organization approves the statute in coordination with the trade union committee and the work collective council.

The workers in the scientific organization must be told at least a month in advance about the coming into effect of the statute on awarding bonuses, changes to it or its repeal.

3. The awarding of bonuses to workers in scientific organizations is accomplished by using assets from the material incentive fund or common wage fund from the portion allocated for these purposes in accordance with the expenditure estimates for the appropriate fund, which the organization's leadership, trade union committee and work collective council have approved; and by using assets arriving in accordance with special bonus-awarding systems (for winning contests conducted between organizations, for assistance in streamlining and innovating, etc.).[1]

4. The statute on awarding bonuses provides for a differentiated approach in encouraging employees, taking into consideration the tasks being specifically solved by them. In this regard, it is possible to pick out five groups being awarded bonuses:

— directors of main activity subdivisions, research workers, and specialists directly engaged in performing scientific research and design, plans and specification and research work;

— workers in the scientific and technical subdivisions (metrological, patent and licensing, etc.);

— leading workers in scientific organizations: the director (chief, manager), his deputies, the chief engineer, the manager (chief) of the planning and production (planning and economic) department, the scientific secretary, and the chief bookkeeper;

— workers on the management staff (besides the above listed leading workers), including employees in the subdivisions' planning and economic department, bookkeeping department, etc.;

— workers.

5. The awarding of bonuses to workers, who are directly engaged in the designing of a scientific and technical product, is carried out upon completion of each specific operation (subject, draft, development, or their stage).

In this regard, the total planned amount of bonuses is passed to the collective of those, who will do the work, before work begins. The bonus is paid to the collective in the prescribed amount after the work is completed and the stipulated requirements for its scientific, technical and economic level have been achieved. When the qualitative indicators of the scientific and technical product exceed the assigned ones, the bonus is raised accordingly.

6. When distributing bonuses within the collective, the contribution of each research worker and specialist to the final work results is taken into account, generally speaking, with a consideration for the functions specifically performed by them. The stated results are described by the indicators for the level of the scientific and technical product stipulated in the contract (task) in comparison with what has been achieved.

When doing this, such evaluation criteria as the scientific and technical level of the scientific, research and development work; the novelty and significance of the concepts and solutions; the complexity of the assigned tasks; the economic and social effectiveness of the work; the time frames for realizing the results obtained during the research and work; the scale in using scientific and technical achievements; the quality with which the documentation is compiled; the decrease in the time for performing research and design work; and the reduction of costs and labor-intensiveness in the work being performed, are used.

It is advisable to define the listed criteria concretely and supplement them in conformity with the organization's specific activity based on the content of the work being performed.

For basic research, it is mainly necessary to take into consideration the depth in studying the subject, which permits essentially new knowledge that outstrips the world level in this area to be obtained; for applied scientific research and design, drafting and technological work, the main stress should be on the scientific and technical level of the work, the observance of technical tasks, the number and scope of inventions and streamlining proposals, the presence of new design (technological) solutions, the absence of errors in the recommendations and work and of violations of stipulated time frames, etc.

The awarding of bonuses to a subdivision director is done in accordance with the work results of the subdivision as a whole and his personal contribution to the carrying out of specific subjects and projects.

The work contribution of research workers, designers and industrial engineers is also evaluated based on the quality and time frames in completing tasks, the display of creative initiative, the amount of work performed, and the absence of errors.

It is advisable to determine each worker's share of the total incentive amount during a meeting of the participants for each operation after it is completed. The actual achievements of a given scientist and specialist should be considered.

In cases where several subdivisions are solving the assigned task, the bonus can be distributed between these subdivisions before determining the incentive amount for each worker: as a preliminary before the beginning of work—depending on the planned amount and complexity of the research or development; and finally after it is completed—considering the actual contribution to the overall results.

7. It is recommended that intermediate work results on the subject and plans and specifications be summed up periodically (at times determined by the average duration of time for that category of workers to complete the work) and that a worker's personal contribution (KTU) to each of the operations, in which he participated during that period, be evaluated. The overall evaluation (KTU) for that period is drawn from this.

Depending on the prevalence of creative elements in a worker's activity or, on the other hand, of repetitive operations, it is advisable to use an expert (non-formalized) or quantitative (formalized) evaluation, respectively, or a combination of them.

An evaluation by experts manifests itself in a description of the successes and shortcomings in a worker's activity based on established criteria for his work results. It is advisable to compare the achieved results with the average indicators for this qualification-functional group for the organization in general (lower than the average, corresponding to the average, higher than the average, and exceptionally high).

A quantitative evaluation of a workers' work results consists of the fact that the degree of achieving selected criteria is expressed quantitatively (in numbers, coefficients). The criteria themselves are correlated based on their significance relative to each other by establishing a specific weight for them in the overall figure (usually, a unit).

The evaluation is calculated as the number of points (or coefficients) for each category, which count in the quantitative expression of that criterion's specific importance.

This method is normally recommended for use when evaluating the work results of research workers, designers, industrial engineers, and other specialists engaged in applied research.

This method assumes the presence of sufficient experience in developing evaluation criteria. That is why its introduction is recommended only when there is confidence in the validity and reliability of the indicators being used to determine labor effectiveness. A quantitative evaluation can also be established in the form of a labor participation coefficient (KTU).

8. It is advisable to award bonuses to workers in scientific and technical subdivisions (metrological, patent and licensing, etc.) based on their fulfillment of obligations to the corresponding subdivisions—the development engineers of the subjects and plans and specifications.

Within the framework of the bonuses prescribed for the subdivision's collectives, a bonus is paid to each worker in a differentiated manner depending on his personal contribution to the collective work results.

The mentioned workers can also be awarded a bonus for carrying out specific subjects and plans and specifications if they were their executors.

9. Leading workers in the organization: the director (chief, manager), his deputies, the chief engineer, manager (chief of the planning and production (planning and economics) department, scientific secretary, and chief bookkeeper, are awarded bonuses for raising the scientific and technical level and effectiveness of research and development with a 100-percent fulfillment of contract obligations.

As an indicator describing the scientific and technical level and effectiveness of research and development, it is recommended that the percentage of research and development performed at a world level be used.

In cases where the qualitative parameters of the activity cannot be compared with the world level (in particular, during the conduct of humanitarian research), it is permissible to evaluate them according to the number of works that have received a high rating from customers.

Higher organizations establish the specific indicators and procedure for awarding bonuses to the directors of a scientific organization in coordination with the appropriate trade union central committee.

10. Workers in the management staff (except leading workers) are primarily awarded bonuses for fulfilling the contract obligations of the organization as a whole with a consideration for the subdivision's work indicators and for raising the scientific and technical level and quality of the research and development being performed.

11. Workers are awarded bonuses for fulfilling production tasks from both the wage fund and the material incentive fund or from the common wage fund.

In those cases where workers are included in a creative brigade, they can be awarded bonuses based on the indicators of its work that are common for all categories of workers.

Bonuses for brigade members within the framework of the total allocated amount are determined in a differentiated manner in accordance with their personal contribution to the overall work results.

12. Only workers, who have demonstrated high achievement in work, are recommended for a bonus.

Those workers, through whose fault low quality fulfillment of the work, a decrease in the main indicators for the technical and economic level of the work being performed when compared with the approved technical goal, an increase in the estimated cost of the work, a violation of the time frame for completing and handing it over to the customer, a distortion of scientific information and production omissions have been allowed, cannot be recommended for a bonus.

The director of the organization draws up a list of these omissions and violations with a consideration for the laws in effect and with the concurrence of the trade union committee; the director of the higher organization draws it up for the leading workers in coordination with the appropriate trade union body.

13. Information from the bookkeeping and statistical accounts, certificates for the introduction of completed work, certificates of the customer's acceptance of the completed work, and—when performing basic and research work—the decisions of the appropriate scientific (scientific technical) council are used to evaluate the fulfillment of the indicators for awarding bonuses.

14. The director of the scientific organization determines the amounts of the bonuses for the collectives or for individual specialists, employees and workers in coordination with the trade union committee and work collective council.

The amount of the bonus for each worker recommended for a bonus is determined, within the limits of the total allocated to the appropriate subdivision, in a differentiated manner and considering his personal contribution to the achievement of high indicators in the organization's activity.

The higher organization determines the sizes of the bonuses for the directors of scientific organizations.

15. The maximum amounts of the bonuses for directors, specialists and employees is as follows:

— for fulfilling the prescribed indicators for the awarding of a bonus—nine monthly official pay rates a year;

— for special systems—2.6 monthly official pay rates a year.

Bonuses based on the results of all-union and republic socialist competition are paid to a leading worker in a scientific organization over and above the mentioned bonuses; however, they cannot exceed 1.4 official pay rates a year.

Bonuses for workers are not limited by maximum amounts.

16. Bonuses to workers for developing and introducing new equipment and advanced technologies and materials, which correspond to the world level or exceed it based on the most important indicators, are paid over and above the prescribed maximum amounts.

Lenin prizes, USSR and union republic state prizes, USSR Council of Ministers prizes, other one-time prizes that are established and paid with the permission of the USSR Council of Ministers, and USSR and union republic state and public organization prizes are also paid above the stipulated maximum amounts.

When calculating the bonus amounts for a collective of workers, the bonuses for specific specialists and employees are, generally speaking, determined in accordance with their personal contribution to the overall work results and are not limited by maximum amounts.

17. The bonuses, which are paid from the material incentive fund (common wage fund), are considered during the calculation of the workers' average wages in the manner established by legislation now in effect.

Supplement

Schematic for Distributing a Collective Bonus Totaling 6,000 Rubles to Those Performing the Work Considering the Personal Contribution of Each Worker, Expressed Through the KTU

No	F.I.O.	Position	Official Pay Rate	KTU	Bonus
1		Department Manager	280	1.6	800
2		Senior Scientific Associate	300	3.0	1500
3		Senior Scientific Associate	320	2.6	1300
4		Lead Engineer	260	2.8	1400

Schematic for Distributing a Collective Bonus Totaling 6,000 Rubles to Those Performing the Work Considering the Personal Contribution of Each Worker, Expressed Through the KTU

No	F.I.O.	Position	Official Pay Rate	KTU	Bonus
5		Lead Engineer	220	0.6	-
6		Engineer Designer, 3d category	200	2	1000
7		Engineer	150	0.8	-
Total			1730		6000

Notes:

1. The KTU is established during a collective's expert discussion of work results based on the general opinion concerning a specific worker's contribution to the overall results or as the product of the coefficients, each of which describes a worker's achievements according to previously stipulated criteria and indicators.

Workers, having low work result indicators (in this example, those below a unit—0.6 and 0.8), are not recommended for a bonus. That is why the KTU total for the collective (brigade, subunit) is 12 (1.6 plus 3.0 plus 2.6 plus 2.8 plus 2.0) in this case. The value of one coefficient unit is equal to 500 rubles (6,000 divided by 12).

The bonuses are computed using the rules for distributing collective wages (500 rubles times 1.6 equals 800 rubles; 500 rubles times 3 equals 1,500 rubles; etc.).

2. The total amount of the bonuses for the main results of this collective's activity, calculated by the increasing total for the year, cannot exceed the actual official pay rate fund of its workers for nine months, including increments and additional payments to the pay rate (the maximum amount for work that does not correspond to the world level). In this example, 1,730 rubles times 9 equals 15,570 rubles.

Decree number 491/26-175 of the State Committee for Labor and Social Problems and the AUCCTU Secretariat dated 18 November 1986 establishes the list of increments and additional payments that can be considered during the computation of the maximum permissible amounts of bonuses.

Footnote

1. The formation of the material incentive fund is accomplished in accordance with the CPSU Central Committee and USSR Council of Ministers decree entitled "On Transferring Scientific Organizations to Complete Cost Accounting and Self-Financing" and with the "Type Statute on Procedures For Forming And Using Material Incentive Funds During 1988-1990 in Enterprises, Associations and Organizations That Have Shifted to Complete Cost Accounting and Self-Financing."

The formation of the common wage fund is accomplished in accordance with the above-mentioned CPSU Central Committee and USSR Council of Ministers decree and the "Type Statute On Forming the Common Wage Fund During 1988-1990 For Enterprises, Associations and Organizations That Have Shifted To Complete Cost Accounting and Self-Financing."

Improvements in Pay Rates for Scientific, Cultural Jobs Urged

18280062z Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 4 Feb 89 p 3

[Article by P. Golis, candidate of economic sciences and docent at Vilnius Polytechnical Institute: "The Poverty of Intelligence"]

[Text] So that no one will accuse me of being subjective, I will begin with statistics. The average monthly earnings of health care workers are 37 percent less than those of a worker in industry. The wages of teachers, following the increase, are 71 percent of the earnings of industrial workers. The situation is still more acute in the sphere of culture. There, the comparative percentage reaches only 56. Scientists live relatively well. Their average earnings are almost equal to earnings in industry (96 percent). If these figures are compared to remuneration in construction, then the contrast would be sharper, since there the earnings are 12 percent higher than in industry.

The material situation of the intelligentsia, as we see, is unenviable. Is there a trend toward its improvement? The statistics also dispel that hope. In recent decades, the situation of those who work in these sectors has even deteriorated. In 1970, the earnings of medical personnel represented 69 percent of the earnings of industrial workers. In the educational system, this figure has reached 81 percent, in the cultural sphere 64 percent, and in the branches of science and scientific services—105 percent.

The figures graphically indicate that in branches producing information, cultural values, and also those which restore human health, there has been a relative impoverishment of workers (a term we recall from political economy). In recent years, the economic position of teachers, physicians, and artists has improved somewhat, but to a lesser degree than the well-being of lathe operators, chauffeurs, and representatives of many other worker occupations.

On the basis of experience, I would be so bold as to say that there has even been an absolute deterioration of the position of the intelligentsia. It is getting more and more difficult for the mental worker to buy a book, since books are getting steadily more expensive, to go to the theater, to go to an exhibition, and so on. The structure of consumption is undergoing simplification and polarization.

The relative impoverishment of this category of people is taking place not only because of differentiation of wages. Ministries and plants are building their own preventoriums, rest homes, polyclinics, and housing. But what can a school or hospital build? After all, it does not turn a profit!

Now, let us look deep down into the branch. After graduation from the VUZ [Higher Educational Institution], the engineer receives 115-120 rubles. A beginning worker receives 160-180. Yet during his studies, a university student goes without certain things, as a rule his parents give him a sizable subsidy, since today the stipend is clearly not enough to live on.

If you follow the destiny of a good worker and an able (and he has to be lucky!) engineer, it turns out that financially the former always stays ahead of the latter. By the 5th or 6th year of their working lives, the able engineer is receiving 160-170 rubles, while the wages of the worker are beginning to exceed the 200-ruble mark. Let us assume that somewhere at the end of his 2d decade of production work the engineer has become the chief of a design office, and his income and bonuses reach 400 rubles. But the worker (a tool and die maker, say) is still receiving more—500 or indeed even 600 rubles.

This indicates that we fail to observe not only the natural differentiation of wages by qualifications, but also the differentiation based on rank. Quite often the supervisor, say, of a shop receives less than his subordinate.

All of this engenders a feeling of social humiliation. One of the consequences is the emergence of shady mechanisms of compensation. We have not yet become fully aware how pernicious they are.

We cannot forget that the inequality as to property is compounded by the distribution of goods through the channels of the "shadow" economy (figure padding, shrinkage, spillage, and so on). To be sure, the educated person can sell his knowledge and conscience. But only for certain groups of educated people are their knowledge and conscience a commodity in demand.

These facts indicate that a sizable portion of young men and women who aspire to do scientific work knowingly condemn themselves to a more modest material situation. In the sphere of education, health care, and other branches for educated people where the pay is poor, most workers have higher education, while in the industrial sector VUZ graduates make up only one-fourth of the labor force.

How are we to explain such a situation, and can it be considered normal?

It would seem that this situation has come about because the entire practice of organizing remuneration along with economic practice as a whole have been built on a wrong conception. The basis of that conception is the production of means of production. Development of the most important lines of heavy industry has been stimulated at the expense of "secondary" branches. This has been the fate not only of education and health care, but also of light industry, the food industry, and so on. That is why the natural objective of production has been forgotten: production always exists for the purpose of consumption. However, the quality of the things being manufactured has been such that many of them are quite difficult to put to use. One gets the feeling that we have developed production solely for the sake of production itself.

The consequences of this are especially obvious today. The branches of intellectual production, or, in other words, of the social infrastructure, have fallen behind. Their plant and equipment have lagged behind, and the level of knowledge of specialists has declined. It is bad when a teacher does not have chalk. It is worse when he does not know how to teach or does not want to teach anyway. This is a logical consequence of an illogical economic policy.

At the same time, is it a logical policy when preference in vocational guidance of 9th graders is given not to the intellectual sectors, but to manual labor? A situation in which society invests immense time and money in selection and training of specialists who could be trained in a few months or weeks in the plant, but adequate resources are not allocated to seek out and train talented intellectuals, can be termed a phantasmagoria. The result is that the main objective is to train as many skilled fitters, lathe operators, electricians, and so on, as possible. And let the rest go into medicine, science, let them become supervisors, and so on. In all times, there has been a different principle of selection: the most able people go where particular attributes and a creative vein are required, and the less able go where these qualities are not needed. This "misery that goes with intelligence" will continue if the attitude toward material and nonmaterial values remains what it has been.

Do we want our children taught by good teachers? Do we want to be treated by skilled physicians? Do we want scientists to be able to look ahead, or do we want them to invent the bicycle? Finally, do we want figures in culture to teach us how to understand beauty?

If yes, then we must understand that when we give to the sphere of nonmaterial production only the crumbs from the common table, we cannot expect our cultural and intellectual potential to be on a high level. It is not enough for a present-day society to have individual fanatic physicians, fanatic teachers, fanatic scientists, and so on. We need broad intellectual and cultural

production at a high level. Efficient material production is otherwise impossible. Cultural and intellectual poverty generates material poverty, and the other way about.

Until we reestablish a deep respect for knowledge and ethics, until we begin to place a value on intellectual and creative work, the bridges and houses built by ignoramuses will be falling down, the lines and shortages of staple commodities will continue to be the eyesores of our everyday life, and the entire world will go on laughing at our products.

It is very important to restore and maintain a high social and economic status for representatives of cultural and intellectual production. On the one hand, the prestige, say, of a physician, is rather high. We do value his work. But only enough to say so. When he graduates from the VUZ, the medical man receives about 110 rubles. The wages of a physician who has been working for 15 years hardly exceeds 200 rubles. At present, a normal family budget is one with 200 rubles for each member of the family. People often evaluate a person not only for what he can do, but also for what he has. We should not dismiss the social principle that consumption must depend on social status. The physician must have the consumption of a physician, the teacher that of a teacher, the engineer that of an engineer.

The obstacles that have been erected in front of any new thought have had the result that many participants in intellectual and cultural production are unable to work creatively and to share the fruits of their labor. That is why manifestations of social passivity, alienation, conformity, and internal emigration have become widespread in the intellectual and cultural milieu.

The system we have had has produced a large number of people with formal education who have only one distinguishing characteristic: their diploma. We are experiencing an immense shortage of really educated people. Like air to breathe, there is a shortage of people who bring to society their ideals, people to whom we could look as standards of morality, civic virtue, and patriotism.

At present, we are poor. We might rephrase the well-known saying: Every society has the system of education, health care, science, and culture it deserves. Time will tell whether we will ever deserve more.

Secrecy Rules Persist Despite Eased Requirements

18140142 Moscow NTR: PROBLEMY I RESHENIYA in Russian No 1 (88) 1989 p 7

[Article: "Retreat of Secrecy. From NTR, No 15, 1988"]

[Text] The series of NTR articles devoted to the problem of protecting state secrets in the press, sparked a large response. We had intended to acquaint the readers with the more typical responses in the next issues of the bulletin, but we decided to speak about one of them now. It is a question of the author's certificate—a document that accompanies an article, which Glavlit had rejected long ago as useless. "Dear Editors! Having trusted your bulletin, I began to discard the author's certificates from the piles of paper accompanying articles. You can imagine the result from the attached response of the department, whose own (explanation by telephone) instructions are dearer that Glavlit's. With surprise, sincerely, Ozhogin."

So, there is the letter. The attached answer of the "department," the USSR State Committee on Use of Atomic Energy, in our opinion, also deserves to be quoted. It informs Comrade Ozhogin that the articles he sent were returned "in connection with the fact that among the registration documents the author's certificates, stipulated by instruction No. 156 of 23 August 1978, are absent."

We called Glavlit, and there they explained to us that some departments have their own, pre-Glavlit procedures for passing along materials intended for publication. Our scientific and technical contingent, committing the results of their work to "open publication," became accustomed to domestic censoring long ago and sees no incongruities whatsoever in it—one does what one must. However, the author's certificate causes, as we see, cheerful perplexity. This jewel of paperwork, needed by one department but not by another, is in fact useless to everyone, since it contains no useful information and is only the author's declaration of the fact that he, so-and-so, wrote said article and is responsible for its content. A signature on the last page of the manuscript, in Glavlit's opinion and in our own as well, is fully adequate for such a declaration.

Something else is unclear here: who among us dictates the weather in censoring? If it is Glavlit, then why are departments ignoring its instructions?

Regulations Governing Use of Duplicating Equipment Described

18000658z Minsk SOVETSKAYA BELORUSSIYA in Russian 4 Feb 89 p 4

[Unsigned article: "'Illegal' Literature?"]

[Text] "It is no secret that in Minsk several informal associations are "passing around" from hand to hand various newspapers and bulletins that have been reproduced in large quantities on duplicating equipment. Are there specific regulations for using duplicating equipment as well as making copies of documents in general?" (From letters received by the BSSR MVD).

According to the ministry's administration for preserving public order, duplicating equipment comes under the jurisdiction of ministries, departments, enterprises and institutions possessing legal status. Documents and materials from open Soviet and foreign publications as well as those pertaining to the activities of the above-mentioned organizations with legal status are copied with the permission of officials attached to these organizations. The requests of organizations other than those possessing legal status and private customers can be filled for a fixed fee. The duplication of materials is accomplished by the written permission of persons who are responsible for the use of duplicating equipment. Before material is reproduced, it is recorded in a special registry.

S&T Information Center Sells Services to Inventors

18140171 Moscow IZVESTIYA in Russian 16 Feb 89 p 2

[Article by IZVESTIYA correspondent A. Zinovyev (Ufa): "Do You Have an Idea? We Will Help Introduce It!"; first paragraph is IZVESTIYA introduction]

[Text] The Bashkir Intersectorial Scientific and Technical Information Center has begun to render intermediary services on the introduction in production of promising developments, inventions, and efficiency proposals.

The workers of the scientific and technical information center are helping the authors of innovations and those, who urgently need them, to find each other. And not just find. The center, if necessary, organizes the drafting of design documentation, the production and testing of prototypes, the assimilation of new equipment and technology at enterprises, and the introduction of new forms of the organization of labor and management.

The new sphere of activity of the center requires of its staff members a knowledge of the conditions of the market of scientific ideas and a good idea of who needs what and who can offer what. Knowing, for example, that the collective of the Immunopreparat Scientific Production Association (Ufa) was giving birth to the idea of a lease contract, the scientific and technical information center offered it its services on the development of the economic, procedural, and organizational support of such a transition. A contract was concluded. For the elaboration and introduction of recommendations the center organized a temporary creative collective and engaged in it performers of the theme on a competitive basis. The specialists in the area of the economics and organization of science, who became members of it, undertook to complete all the work in 3 months. Even before that the center completed the order for the introduction of the lease contract in the hotel system of Ufa and at the Bashzhilkommunproyekt Institute. For

intermediary services up to 40 percent of the contract price of the work, which was performed for the client by the temporary creative collective, is being transferred to the center.

Back in the middle of 1987 the Bashkir Intersectorial Center in conformity with the decree of the USSR State Committee for Science and Technology began an economic experiment—it began to sell its information products and services (before that they were rendered free of charge), thereby turning from a budget-carried organization into a cost accounting one. Our newspaper wrote about the first steps of this experiment ("One Must Pay for Information"). And now the center is taking the next step in the direction of self-financing and self-support [samookupayemost].

"The extensive assimilation of intermediary services on the introduction in the national economy of advanced know-how," says N. Tsibulin, director of the Bashkir Scientific and Technical Information Center, "will enable the collective of the center as of the second quarter of this year to change over to full cost accounting. The primary thing is that the mechanism of introduction is being adjusted, the way from the idea to its embodiment is being shortened and sped up."

Inventors Society Comments on Proposed Patent Law

18140173 Moscow IZOBRETATEL I RATSIONALIZATOR in Russian No 11, Nov 88 pp 4-5

[Article by S. Grachev under the rubric "The Spirit of the Times": "The Draft of the Law: The Third Discussion. A Representative of the Journal IZOBRETATEL I RATSIONALIZATOR Was Invited for the First Time to a Meeting of the Presidium of the USSR Council of Ministers"; capitalized passages as published]

[Text] A representative of IZOBRETATEL I RATSIONALIZATOR for the first time had occasion to be at a meeting of the Presidium of the USSR Council of Ministers, and here our vital invention theme is still on the agenda.

Important things, which set a certain mood for all the meeting participants, preceded the discussion.

The first is that THEY WERE CONSIDERING THE DRAFT OF THE LAW IN THE COUNCIL OF MINISTERS FOR THE THIRD TIME (in January, then in March, and the present discussion). I do not know how often it happens in the practice of the work of the Council of Ministers that the Presidium would return to the same question three times in the course of half a year and planned a return soon to the same theme a fourth time—but, without a doubt, the increased demandingness on the law, which is called upon to radically change and improve the state of affairs with invention in our country, is visible in this.

That this situation is far from bright is now already obvious, I dare say, to everyone. But to return the draft three times for revision and to state three time: it is no good, it is no good, it is no good, here, obviously, is the aspiration to settle the question fundamentally.

The second thing. From the practice of the preparation of the draft of the law for how many times, unfortunately, it was possible to be convinced that the department, however it exerts itself and with whatever good impulses it burns, is not capable, alas, of overcoming its narrow interests and looking at the broad scope of national interests. THE STATE COMMITTEE FOR INVENTIONS AND DISCOVERIES DEMONSTRATED THIS BRILLIANTLY. The government commissioned precisely the Committee to prepare the draft of the Law on Invention. And why not? The very first draft, which originated in the Committee and was sent to various instances for the gathering of opinions, comes to mind. This draft was also discussed at one of the expanded presidiums of the Central Council of the All-Union Society of Inventors and Efficiency Experts. What a discussion that was! More than 10 people spoke, and none found kind words for the draft—with the exception, incidentally, of the representative of the State Committee for Inventions and Discoveries, Deputy Chairman N.V. Mironov. The members of the presidium and the active members of the All-Union Society of Inventors and Efficiency Experts, as they say, smashed the project to smithereens, although in an hour-long speech before that the deputy chairman of the State Committee for Inventions and Discoveries depicted the draft as a progressive deed which vigorously advances Soviet invention. But the speakers proved in a friendly manner that in essence this was the same Statute on Discoveries, Inventions, and Efficiency Proposals, which had become hopelessly obsolete as of 1973, which is fundamentally incapable of settling any vital question of scientific and technical progress, and which now hangs as a dead weight on the neck of our economy. Did we and do we really expect this? Does our invention legislation really need a beauty treatment, and not a decisive turn?

The State Committee for Inventions and Discoveries was not able to depart from its own instructions, explanations, and decrees. Their reshuffling did not lead and could not lead to a qualitatively new standard document. Many members of the commission had to be replaced. Vice President of the USSR Academy of Sciences Academician Ye.P. Velikhov headed it. The draft, which was prepared by the new commission, was also submitted for discussion.

I can imagine well how it pains the personnel of the State Committee for Inventions and Discoveries to read this. But did it not pain inventors to live according to the regulations of the Committee—regulations, which turned the inventor into the pathetic figure of a petitioner, who wheedles everything, starting with a considerate attitude of the expert commission to the application and ending with introduction and—the talk of the town—a reward? And still it would be too easy and, as hot heads, alas, often do, too superficial to pile all the troubles of domestic invention onto the Committee. If it were as wise as Solomon, it would not succeed by any most perfect law in changing the state of affairs without the overall transformation of the economy, which is being carried out only now.

That draft of the law, which was discussed in the Central Council of the All-Union Society of Inventors and Efficiency Experts, became for the Committee a swan song—alas, an ignominious song in officialese. The experiment with the centralized payment of the author's rewards did not succeed—although at one time what cheerful statements issued from the mouths of responsible officials of the Committee! The State Committee for Inventions and Discoveries did not maintain the status of an independent organization and was included in the USSR State Committee for Science and Technology as one of its subdivisions. The State Committee for Inventions and Discoveries was also not able to cope with the alluring role of the creator of the law. It did not turn out. It did not work out. A breadth of views, a willingness for decisive changes, and the ability to implement these changes were lacking. But who, it would seem, if not the Committee is to know all the needs and diseases of Soviet invention, which in economic effectiveness (well,

is it not a laughing matter?) still will simply not attain the level of rationalization, instead of exceeding it by tens and hundreds of fold; who if not the Committee is to attempt at the same time, since such an exceptional opportunity has been afforded, in one basic document to bring creative technical work up to a qualitatively new level, which satisfies the demands of restructuring? But just imagine—it proved to be too much.

Those who gathered at the Kremlin knew this sad experience, and although the experience was negative, it provided a positive stimulus: the cosmetic correcting, to which the State Committee for Inventions and Discoveries attempted to confine itself, will not go through. A departure from tenacious bureaucratic practice, a boldness of decisions, a breadth of thinking—this is on what the new draft should be based. The meeting participants expected this and strove for this.

All the same, this was not an ordinary meeting. In addition to the members of the Presidium about 100 people—prominent inventors from throughout the country, scientists, specialists, managers of associations and enterprises, representatives of public organizations—were invited to the Kremlin. In the opening speech MEMBER OF THE POLITBURO OF THE CPSU CENTRAL COMMITTEE AND CHAIRMAN OF THE USSR COUNCIL OF MINISTERS N.I. RYZHKOV said that he would like to listen not to ministers, but to those, whom the new law will concern first of all, who are directly connected with invention, that is, first of all the very authors of inventions. And the ministers did not speak—they listened to the inventors, scientists, and specialists.

FIRST DEPUTY CHAIRMAN OF THE USSR STATE COMMITTEE FOR SCIENCE AND TECHNOLOGY I.M. BORTNIK told about the basic directions of the draft of the law. The developers of the draft believe that an invention is a commodity, and it should be included with full rights in the system of commodity-money relations. It is proposed to define an invention by three attributes: novelty, an unobvious nature, and practical applicability. The protection of an invention is only by a patent, which is in effect for 15 years. The right to an invention can belong both to the author and to an enterprise—subject to the conditions of the development of the invention. An invention belongs to the author in the following three cases: 1) if the invention was developed under home conditions; 2) if the invention was developed at an enterprise, but is not connected directly with its specialization; 3) if the invention was developed at an enterprise and is connected with its specialization, but was devised outside a specific technical assignment. And in only one case is the enterprise the patentee—if the invention was developed in accordance with the specialization of the enterprise in connection with the fulfillment of a specific technical assignment. But in this case a number of restrictions are also imposed on the enterprise: if the enterprise does not submit an application for the invention within a specific period, if it does not use the invention in 2 years, all the rights to the invention pass to the author. A variant is possible: all the rights to an invention always belong to the author, but the enterprise in the employment contract can stipulate its interest in owing inventions, if such will be developed in the process of work. Deferred examination is being introduced. Prior to the making of a full examination a temporary patent, which is already a commodity, is issued. During the first 3 years after the introduction of an invention all 100 percent of the profit remains at the disposal of the enterprise. Deductions for the budget begin only with the 4th year of use. The Innovation Fund of the country is being organized for the financial support of especially promising inventions—it is formed by the deduction of 1 percent of the profit, which has been derived as a result of the use of inventions. The Patent Court is being introduced for the hearing of invention cases. There is no maximum author's reward—all the enterprises, however many of them there are, allocate to the author of the used invention from the profit, which was derived as a result of this, not less than 5 percent. For a delay in the payment of the reward the enterprise plays the inventor a substantial fine.

While listening to the speakers, it was possible to note with satisfaction that many, if not all, of the basic features of the proposed draft, as well as the supplements to it in one form or another were voiced by readers of IZOBRETATEL I RATSIONALIZATOR in recent years under the rubrics "The Improvement of Legislation," "The Rostrum," and "Problems." We have had publications on the protection of an invention only by a patent, on the advisability of deferred examination, on the Innovation Fund, on the Patent Court....

How did the audience receive the new draft of the law? There was no unanimity. Except in just one thing: the legislation, which exists now in mass creative technical work, has thoroughly compromised itself and cannot be the basis for the further development of the economy. Qualitative changes are necessary. Everyone agreed with this. But precisely what changes are most expedient—here everyone had his own opinion. There is no point, obviously, in retelling them after the publications that have occurred in more rapid sources of information and for the reason indicated about (the repetition of the ideas expressed earlier by the same people or by others in our journal). I will cite just a few views which give, in my opinion, new food for thought.

S.N. Fedorov, honored inventor of the USSR, general director of the Mikrokhirurgiya glaza Interbranch Scientific Technical Complex, winner of the competition of IZOBRETATEL I RATSIONALIZATOR "Technology Is the Chariot of Progress": "The draft of the law anticipates too much. It is not timely. We are putting the cart before the horse. For the present no one needs inventions, as well as the inventor. The reason is that in practice there is no market for invention. No one gets anything from introduction. The invention as a commodity will work only in case of the changeover to full

cost accounting. But for the present this does not exist. The invention will not be able to become a commodity in a system, where commodity-money relations are developed very poorly. The draft was not prepared economically. Without a market there is no invention."

L.N. Koshkin, honored inventor of the USSR, general director of the Rotor Interbranch Scientific Technical Complex, winner of the competition of IZOBRETATEL I RATSIONALIZATOR "Technology Is the Chariot of Progress" (see IZOBRETATEL I RATSIONALIZATOR, No 6, 1980, p 2; No 1, 1983, p 4; No 9, 1983, p 2; No 1, 1988, p 35): "Progress is possible only when everyone needs it. If someone does not need it, if only one link in the entire chain of economic relations, progress will be checked."

Corresponding Member of the USSR Academy of Sciences B.G. Gribov, honored inventor of the RSFSR, director of a scientific production association (Leningrad): "All the rights to an invention should be given to the author—this is his personal work."

Academician V.N. Kudryavtsev, director of the Institute of State and Law of the USSR Academy of Sciences: "One must not give all the rights to an invention to the inventor. The enterprise should also have the right to the patent. Otherwise the enterprise will not have an interest in introduction."

A.Z. Pruzhinin, inventor, head of a laboratory of the Moscow Institute of Construction Engineering: "The inventor is the basic figure of technical progress, this is a person of state importance. We need a USSR Union of Inventors."

L.I. Danilov, honored inventor of the USSR, chief mechanic of the Cherepovetsk Metallurgical Plant, member of the presidium of the Central Council of the All-Union Society of Inventors and Efficiency Experts (see IZOBRETATEL I RATSIONALIZATOR, No 7, 1984, p 2): "The Innovation Bank, I believe, must be put under the jurisdiction of the All-Union Society of Inventors and Efficiency Experts."

Yu.S. Polinov, honored inventor of the RSFSR, senior engineer of the All-Union Correspondence Electrical Engineering Institute of Communications (see IZOBRETATEL I RATSIONALIZATOR, No 12, 1987, p 5): "They are preventing us from establishing a Union of Inventors, and for this reason we had to take the path of an informal association."

V.A. Smirnov, head of the Division of the Protection of the Rights of Authors of the Central Council of the All-Union Society of Inventors and Efficiency Experts: "For incomprehensible reasons representatives of the All-Union Society of Inventors and Efficiency Experts were not included in the group of developers of the draft. It is difficult to explain this. From the definition of an invention, which is cited in the draft of the law, it is necessary to eliminate the concept 'an unobvious nature,' for everyone will understand in his own way what an unobvious nature is."

S.F. Shtelmakh, honored inventor of the RSFSR, representative of the Moscow Machine Building Plant imeni M.I. Kalinin: "There are many shortcomings in the draft. It is too early to publish it for general discussion."

B.I. Ushakov, best inventor of Moscow of 1987, head of a sector of the All-Union Scientific Research Institute of Reinforced Concrete of the USSR State Construction Committee: "The enterprise, at which an invention was developed, can deliberately hinder introduction, if an old product yields a good profit. In this case the enterprise will not have an interest in introduction. The inventor himself will find a better enterprise for introduction. One must not chain the inventor to an enterprise as to a galley."

Doctor of Economic Sciences O.M. Yun, deputy chief of a department of the USSR State Planning Committee: "The enterprise is the environment, in which the creative potentials of an author are most completely revealed and realized. In the case, which is envisaged by the draft, the invention should belong to the enterprise."

Doctor of Juridical Sciences S.V. Filippov, deputy general director of the Soyuzpatent All-Union Association of the USSR Chamber of Commerce and Industry, member of the working group for the preparation of the draft of the law: "They are driving the inventor into the framework of the job-related invention. The role of the enterprise is exaggerated—for far from always is the enterprise, where the invention originated, the best one for its introduction."

Vice President of the USSR Academy of Sciences Academician Ye.P. Velikhov, chairman of the group for the preparation of the draft: "It is possible to settle the question of the exclusive right to an invention by a compromise, if you indicate in the patent two patent holders—the author and the enterprise, where the invention was developed. Moreover, both patent holders enjoy equal rights, but dispose of the invention on the basis of an agreement that has been concluded between them."

The discussion of the draft of the Law "On Inventive Activity in the USSR" lasted 6 hours. Summarizing the discussion, N.I. Ryzhkov noted that "well-reasoned, but opposing points of view were expressed. However, it is clear that the draft for the present is not ready for publication for general discussion, it is still necessary to do some work on it. In invention in our country enormous obstructions have built up....."

Some 20 years ago, when N.I. Ryzhkov worked as the chief engineer of a plant, by virtue of his official position he dealt with invention affairs. And the discussion showed that "in these 2 decades hardly anything has changed." It is necessary that the law would undo the

basic invention problems. "Yes, this is correct, if the economic environment in the country does not change, the law will not work, it will get into the wrong atmosphere. But the law is needed today. We cannot wait for the end of the economic reform. We have always lost because the economic environment seized inventions, although this is the best part of scientific and technical progress. If we do not find levers so that technical innovations would be pursued, no law will help. A law of precisely direct action, with specific standard articles, so that it would not become cluttered with instructions and explanations, is expedient. For instructions and explanations, we know, can emasculate everything. The basic thing in the law, of course, is the exclusive right to the invention. To whom should it belong? There is no reconciliation between the speakers, the majority expressed opposing points of view. The proposal of Velikhov—to find a balance of the interests of the enterprise and the author—is interesting. It is possible to take the examined draft as the basis for further work."

Estonian Academy of Sciences Plans To Rewrite Statutes

18140165 Tallin SOVETSKAYA ESTONIYA in Russian 6 Jan 89 p 1

[Article by R. Viyt: "New Statutes for Academy of Sciences"]

[Text] **The ESSR Academy of Sciences General Assembly, which discussed the question of new statutes for the Academy, was held in Tallin on 4 January.**

K. Rebane, ESSR Academy of Sciences president, opened the meeting.

Academician E. Parmasto gave a report, which noted:

We have repeatedly asserted that the Academy of Sciences and its statutes have enabled our scientists to keep democratic traditions even at a time, when they were in fact made into a farce in other spheres. I do not think that the academy's statutes in themselves contribute to developing the scientist's creative thought. Nevertheless, today, when the value of education and of science is growing, the legal basis for our activity—the academy constitution—is in need of change.

What is the statute currently in effect? Above all, it is a document faithfully copied from the USSR Academy of Sciences statutes. One must agree with A. Logunov, rector, Moscow State University, who stated at the 19th All-Union Party Conference that, among the developed countries, we probably hold first place in terms of spreading the virus of conservatism in science.

The speaker dwelled further on the basic principles which should be reflected in the new statutes. He emphasized the need to guarantee the protection of the priority of scientists and scientific institutions from the influence of command-order extra-scientific forces, offices and bureaus. Out of this, a need arises to seriously reduce centralization, the number of instructions "from above," and petty management, and to elevate competence both in conducting research, as well as in managing scientific work, to a state of dignity. Democracy in science should be expanded both in electing academy members and managing its agencies, as well as in determining the directions of scientific work. We should reject the coordination of natural and social sciences on republic-wide scales, and we must reject the coordination stance that the Academy of Sciences is wiser than everyone else.

There are 86 clauses in the draft of the new academy statutes. Of these, five were transferred unchanged, and another 10—with some change in the formulation. There will be 26 more clauses in the statutes, compared to the previous version.

The rights and responsibilities of academy members and establishing the status of a foreign academy member were discussed in detail at the assembly.

Academician Ya. Eynasto gave a supplementary report.

Different opinions regarding the future statutes were voiced in many speeches.

Directors of scientific institutions were also confirmed at the ESSR Academy of Sciences General Assembly: A. Freyberg—as director of the Institute of Physics, Yu. Yaaksoo—of the Institute of Cybernetics, D. Kalo—Institute of Geology, O. Priylinn—Institute of Experimental Biology, A. Tarand—Tallin Botanical Gardens, O. Lugus—Institute of Economics, and T. Seylental—Institute of Language and Literature.

The General Assembly decided to send the USSR Academy of Sciences Presidium a proposal to nominate K. Rebane, ESSR Academy of Sciences president, as a candidate USSR people's deputy. E. Lippmaa, director of the Institute of Chemical and Biological Physics, was nominated as a candidate USSR people's deputy for the Central Tallin National-Territorial Electoral District No. 456.

M. Titma, Estonian CP Central Committee secretary, participated in the assembly.

Activities of Presidium of LaSSR Academy of Sciences Summarized

18140117 Riga IZVESTIYA AKADEMII NAUK LATVIKSKOY SSR in Russian No 7, Jul 88 p 123-124

[Article: "In the Latvian SSR Academy of Sciences Presidium"]

[Text] The LaSSR Academy of Sciences Presidium and the Latvian republic Presidium of the Trade Union Committee for Workers in Education, Higher Schools and Scientific Institutions resolved, according to the outcome of the socialist competition among accounting workers in institutions, enterprises and organizations of the LaSSR Academy of Sciences, to award, among budget institutions, first place to the accountants' collective of the Institute for Polymer Mechanics; second place to the collective of the LaSSR Academy of Sciences Bookkeeping Department; third place to the accountants' collective of the Physics and Energy Institute; among economic enterprises and organizations, first place was awarded to the accountants' collective of the IOS Experimental Plant; second place to the accountants' collective of the Scientific Instrument Building SKB [Special Design Bureau]; and third place, to the accountants' collective of the Energy Engineering SKB with experimental production.

The LaSSR Academy of Sciences [AS] Presidium gave the Honorary Award of the Presidium to M.M. Sukharev, deputy director of general affairs at the Institute of Physics, for successes achieved in creating a material and technical base for the institute, for contributing to the fulfillment of scientific tasks, and for active social work.

At the 12 May 1988 Meeting

The LaSSR AS Presidium heard the commission report (U.F. Suna, chairman, doctor of philosophical sciences) and examined the results of work by the Institute of Philosophy and Law for 1984-1987. It noted that the institute had published a number of monographs and collections and had defended two doctoral and five candidate dissertations during the reporting period. However, these indicators are lower than those of other social sciences institutes or of philosophers and sociologists, working in other scientific institutions in the republic. More than 7 years have passed since the institute was created, but presently a specific subject-matter had still not been determined in all areas of work, on which the institute does or could in the future provide a greater contribution to developing science and to solving ideological problems topical for the republic. It was noted that the previous Presidium resolution on the institute's activity for the years 1981-1983 has only been fulfilled in part. The leadership of the Institute of Philosophy and Law was shown the need to radically restructure the institute's activity.

A report by presidium member Academician U.E. Viyestur on the development of foreign economic relations for the academy's institutions was heard and discussed. Recently, the institutes' activeness in the area of foreign economic relations has increased somewhat, and in addition, certain reserves for further development exist. In the resolution which was passed, the institutes were instructed to find new subject-matter for establishing foreign economic contact, the conduct of transactions through the "Inter-Latvia" V/O was recommended, and the need for the patent study of applied subject-matter was emphasized. It was deemed expedient to form a reserve wage fund under the Presidium for financing unplanned work on foreign economic agreements.

The report by Academician A.A. Drizul, vice-president, on training scientific cadres was heard and discussed. For 1986-1987, 13 doctoral and 83 candidate dissertations were defended and the plan for accepting graduate students was fulfilled. However, the indicator for graduate students who have successfully graduated is 22.7 percent. In a number of institutes, work done by graduate students is insufficiently controlled and inefficient work by scientific leaders is rarely discussed at scientific council meetings. Institutes are devoting little attention to the timely search for specialists to be accepted as graduate students. The resolution which was passed addresses the need to improve the development of plans for training scientific cadres and for selecting graduate students on a competitive basis, and the need to turn particular attention toward fulfilling plans for doctoral dissertations.

A report was given by Academician Y.A. Liyelpeter, vice-president, and the list of republic scientific and technical and socioeconomic programs in which Academy of Sciences institutes take part for the 13th 5-year period was approved.

The LaSSR AS Prize imeni Fritsis Deglav was awarded for the best work in the field of economics to *V.R. Praude,* doctor of economic sciences (Latvian State University imeni P. Stuchki), for a series of works on improving the economic mechanism in industry and trade (problems of theory and practice).

The LaSSR AS Prize imeni Yanis Sudrabkalna was awarded for the best work in the field of art criticism to *I.V. Grauzbyn,* docent (Latvian State Conservatory Imeni Ya. Vitol), for the monograph "*V Tysyachu Golosov Zvuchit Organ*" [The Organ Sings in a Thousand Voices].

P.V. Gulyan, LaSSR AS corresponding member, was approved as chairman of the expert committee on the Prize imeni Fritsis Deglav.

In connection with the LaSSR AS General Meeting's approval of a new procedure for electing institute directors, the term of Academician E.Ya. Lukevits, director, Institute for Organic Synthesis, was extended until the holding of elections.

A number of employees at the Institute of Microbiology imeni Avgust Kirkhenshteyn appealed to the USSR AS Presidium regarding the conferment of the scientific title of senior scientific associate.

The Honorary Award of the Presidium was awarded to *R.E. Vegner,* senior scientific associate, Institute of Organic Synthesis, and to *Ya.Ye. Plyavinsh,* chief technician, Experimental Plant of the Institute for Organic Synthesis.

The Honorary Award of the Presidium was awarded to: *D.A. Vardaun,* senior scientific associate, Institute of Language and Literature imeni A. Upit, candidate of philosophical sciences, for fruitful scientific work in the field of literary criticism and active participation in social life; and *I.N. Ozarniy,* scientific associate, Physics and Energy Institute, for successes achieved in working out the problems of developing the LaSSR's energy supply and for active participation in social life.

At the 9 June 1988 Meeting

Results of the activity of the Institute of Microbiology imeni Avgust Kirkhenshteyn for 1984-1987 were examined and it was noted that over the reporting period the share of studies on molecular genetics had increased, theoretical research on the interaction of the virus and the cell, as well as research on theoretical microbiology, including the molecular genetics of microorganisms, had received further development. The tasks of exploring and studying of new inhibitors of viral activity, of creating highly sensitive diagnostic methods for the indication of viruses and preparations for preventing viral infections in people, animals and plants, are being successfully resolved. Highly productive cultures of producers of biologically active substances and organic acids

have been created. The volume of application of scientific research developments has increased. The institute's material and technical base has been strengthened.

Meanwhile, however, shortcomings at the institute which were noted in the previous examination have not been eliminated. The growth rate for cadres with higher skills is low, a significant share of the graduate students are completing graduate school without presenting dissertations, and the certification that was conducted in 1986 (six laboratory leaders over 60 years old) has turned out to be ineffective.

The presidium has recognized the work of the Institute of Microbiology imeni Avgust Kirkhenshteyn for 1984-1987 as being positive. It was deemed necessary to increase the share of basic research when forming the long-term plan for the institute's research work until the year 2000. It directed attention to the need to rejuvenate the management staff of the institute's subdivisions, as well as to raise the responsibility of leaders for the level of work on the subject-matter being implemented, and for the volume and effectiveness of the application of scientific developments.

A question on the work of the "Local Information Networks" RMNTK was heard and discussed. The slow development of the RMNTK's activity and the inadequate level of results was noted. For purposes of expanding the application of RMNTK developments, it was deemed necessary to turn to the republic's Gosplan with a proposal regarding the expediency of organizing a Service Center and creating an experimental base for the "Local Information Networks" RMNTK. The Institute of Electronics and Computer Equipment was instructed to conduct work related to developing economic forms of cooperation with production associations and enterprises.

The question of the work by the Atomic Reactor of the Institute of Physics was heard. In recent years, the Institute of Physics and other republic organizations have obtained results of a certain interest for the development of science and technology, on the basis of the Atomic Reactor.

The presidium approved the scientific and technical research carried out at the Atomic Reactor of the Institute of Physics. It was deemed necessary to determine, according to a calendar plan, the order of priority for basic measures which guarantee the safety of the research nuclear reactor and the criticality bed [kritstenda]. In connection with the question of the further operation of the Atomic Reactor, in order to examine all aspects of this problem, a commission is to be created under the chairmanship of Academician A.F. Krogeris, academician-secretary, Department of Physical and Technical Sciences, involving a broad range of specialists. The staff of the Council for Coordinating Research at the Atomic Reactor of the Institute of Physics under the LaSSR Academy of Sciences Presidium (chaired by P.T. Prokofyev, corresponding member) was approved.

The course of implementing the LaSSR AS Presidium resolution of 16 April 1987 "On the Result of Examining the Activity of the Basic Library for 1983-1986" was examined. Over the last period, the Basic Library has increased the hours for serving readers in the Department of Manuscripts and Rare Books and this department has begun organizing a systematic catalog. The solution of the cadre problem has improved and the demand for small-circulation publications by academy institutions is being more extensively met by the Basic Library.

The presidium noted that the Fundamental Library has partially fulfilled a number of points for the resolution under consideration. A statement by the Basic Library and the Department of Social Sciences to the effect that the resolution will be fully implemented was taken into account.

Commentary on Montreal Protocol to Protect Ozone Layer

18140145a Moscow NTR: PROBLEMY I RESHENIYA in Russian No 1 (88), 1989 p 7

[Interview of Yuriy Mikhaylovich Sharkov, deputy chief of the International Legal Administration of the USSR Ministry of Foreign Affairs, by A. Malinov under the rubric "Panorama": "The Montreal Protocol Is in Operation"—"Attention: The Ozonosphere!"; first paragraph is source introduction]

[Text] On 1 January of this year, the International Montreal Protocol for Protection of the Earth's Ozone Layer went into effect. "Not counting certain positive steps in the field of disarmament, this is actually the first constructive example of international cooperation in the solution of global problems looming over mankind," Yu.M. Sharkov, deputy chief of the International Legal Administration of the USSR Ministry of Foreign Affairs, emphasized in an interview for NTR.

NTR: PROBLEMY I RESHENIYA: Yuriy Mikhaylovich, please acquaint our readers with the special features of preparation of this document and the conditions of it going into force.

Yu. M. Sharkov: As you know, after several years of intensive work by scientists and diplomats of different countries, an agreement was reached in Montreal toward the end of 1987 on freezing and subsequent curtailment by the world community of production of chlorofluorocarbons, the principal ozone destroying substances.

It was also agreed that the agreement would legally go into effect under the following conditions.

The so-called framework Vienna Convention of 1985, that is, the one containing the general fundamental provisions, goes into force. The condition was fulfilled and the convention went into force. Second, ratification is required of the actual protocol by a minimum of 11 states. Last September there were already 13 ratifications.

And, finally, third: it is required that these 11 countries be the users of two-thirds of the world's consumption of chlorofluorocarbons. After the USSR had approved the protocol and the European Economic Comminity had joined the convention, the necessary two-thirds were mustered. The protocol is to go into force on 1 January.

NTR: PROBLEMY I RESHENIYA: As we know, the Soviet Union officially joined the protocol only in September 1988 and was one of the last to do so, although it has been an active adherent of it since the conception of the actual idea. How is this fact to be explained?

Yu. M. Sharkov: Events developed as follows. At the working group stage, two approaches were actively discussed. The United States, Canada and the countries of Northern Europe insisted that the largest possible percentage of reduction be prescribed. This was resisted by the countries of the European Economic Community. And before the last decisive meeting in Montreal, a compromise was reached: in the course of 10 years, the consumption of ozone destroying agents was to be reduced by 20 percent. With this, we left for our respective homes. Accordingly, this figure was included in our proposals for approval by the government. However, the Americans succeeded in convincing the countries of the European community to go along with their variant—to assume additional obligations and to add another 30 to the 20 percent. A total of 50 percent. We learned about this agreement only in Montreal where already the majority of the participants came out with a proposal to conduct the work in two stages: first to freeze the production of ozone destroying agents at the 1986 level and then as of 1993 the reduction would be 20 percent and then as of 1998 still another 30 percent. Our delegation was not ready for such a decision, for the adoption of such an additional commitment would have required a cardinal restructuring of our industry. The analysis of such a decision required time. For this reason we signed only the concluding act without signing the protocol at the Montreal conference. Nevertheless a solution was found, and all the participants of this work—the government, chemical scientists and production people—reached the conclusion that the USSR was in a position to fulfill these commitments.

NTR: PROBLEMY I RESHENIYA: What is the practical significance of 1 January for the countries that ratified the Montreal protocol?

Yu. M. Sharkov: From this day forward, they will have to freeze their production at the 1986 level. This applies to all the countries except the USSR.

NTR: PROBLEMY I RESHENIYA: Please explain.

Yu. M. Sharkov: The fact is that for countries with a planned economy, particularly our country, taking into consideration that the 5-year period was already "committed," an exception was made. We are freezing our production of chlorofluorocarbons at the 1990 production level. And then beginning with 1993 we shall start to reduce it by 20 percent.

NTR: PROBLEMY I RESHENIYA: Has a mechanism been provided of international inspection and monitoring of observance of the agreement?

Yu. M. Sharkov: So far the inspection question remains open. Each country has to provide its data to the convention's special secretariat. But the actual protocol provides that the question of inspection will be examined at the first international conference of the participating countries this year.

NTR: PROBLEMY I RESHENIYA: Do other examples exist of such concrete fruitful efforts of the world community in the area of solution of global problems? Of course, I do not have in mind work in the field of disarmament.

Yu. M. Sharkov: Agreements were reached somewhat earlier on curtailment of sulfur emissions and their drifting across frontiers. Our country, for example, has reduced them by 30 percent.

NTR: PROBLEMY I RESHENIYA: But why did this take place unknown to the public?

Yu. M. Sharkov: Obviously because this was only in the beginning of the'80s, when glasnost was as yet not "working."

But for the sake of fairness, it is necessary to point out that the sulfur convention applied basically to Europe. The ozone agreements concern the entire planet. And in this sense, this is truly the first real example of constructive cooperation of most of the planet's countries in the field of solving global, particularly ecological, problems.

Azerbaijan Scientist Elected to American Chemical Engineers Institute

18140148a Baku BAKINSKIY RABOCHIY in Russian 29 Dec 88 p 2

[Article (AZERINFORM): "Recognition of the Services of a Scientist"]

[Text] K.Yu. Adzhamov, a professor of the Chair of Physical Chemistry of the Azerbaijan Institute of Petroleum and Chemistry imeni M. Azizbekov, has been elected a member of the American Institute of Chemical Engineers. On New Year's Eve the 47-year-old Azerbaijan scientist received a diploma which certifies his election to this authoritative organization, the headquarters of which are in New York.

"More than 10 years of contacts link us with colleagues from the United States," Keykavus Yusufovich related. "Our chair has conducted within the framework of Soviet-American scientific cooperation joint research in the field of oxidation catalysis with scientists of the University of Wisconsin (Milwaukee), there have been joint publications in editions of the USSR Academy of Sciences. Here foreign specialists are doing practical studies and are studying in graduate courses. All this, obviously, attracted the attention of the institute, which extensively supports the scientific research and contacts of scientists of different countries and organizes meetings of colleagues.

"At the chair research is being performed on the development of highly efficient catalysts for petrochemistry, which are involved in the processes of the production of solvents, acetic acid, intermediate products for the obtaining of acrylic plastic, and other chemical substances. Many developments of scientists have been introduced in the national economy, particularly at the Baku Petroleum Refinery imeni XXII syezda KPSS, the Moscow Petroleum Refinery, and enterprises of Orenburg and Krasnodar. A number of works are connected with ecological problems, particularly the neutralization of the exhaust of engines of motor vehicles and the cleaning of the waste gases of petroleum refining and petrochemical enterprises."

BSSR State Prizes in Science, Technology Awarded

18140148b Minsk SOVETSKAYA BELORUSSIYA in Russian 30 Dec 88 p 3

[Decree of the Belorussian CP Central Committee and the Belorussian SSR Council of Ministers "On the Awarding of the 1988 Belorussian SSR State Prizes in Science and Technology"]

[Text] Having considered the suggestion of the Committee for Belorussian SSR State Prizes in Science and Technology, the Central Committee of the Communist Party of Belorussia and the Belorussian SSR Council of Ministers resolve:

To award the 1988 Belorussian SSR State Prizes to:

In Science

1. Doctor of Physical Mathematical Sciences Professor Andrey Aleksandrovich Bogush, head of a laboratory of the Institute of Physics imeni B.I. Stepanov of the Belorussian SSR Academy of Sciences; Candidate of Physical Mathematical Sciences Lev Grigoryevich Moroz, senior scientific associate of the same institute—for the series of works "The Classical Field Theory of Elementary Particles," which were published in 1967-1987.

2. Academician of the Belorussian SSR Academy of Sciences Afanasiy Andreyevich Akhrem, honorary director of the Institute of Bioorganic Chemistry of the Belorussian SSR Academy of Sciences; Candidate of Medical Sciences Nadezhda Viktorovna Piven, head of a laboratory, Candidate of Chemical Sciences Oleg Vasilyevich Sviridov, leading scientific associate, Doctor of Chemical Sciences Oleg Anatolyevich Strelchenk, director, Doctor of Chemical Sciences Vadim Leonidovich Chashchin, deputy director, workers of the same institute; Doctors of Medical Sciences Professors Aleksandr Sergeyevich Ametov and Yuriy Nikolayevich Kasatkin, heads of chairs of the Central Order of Lenin Institute of the Advanced Training of Physicians of the USSR Ministry of Health; Inna Anatolyevna Okhotina, senior engineer of the USSR State Committee for the Utilization of Atomic Energy—for the development of the scientific principles, the development of the technology, the organization of the pilot production, and the introduction in health care practice of X-ray diagnostic kits.

3. Corresponding Member of the USSR Academy of Medical Sciences Nikolay Nikolayevich Aleksandrov (posthumously), former director of the Scientific Research Institute of Oncology and Medical Radiology of the Belorussian SSR Ministry of Health; Doctor of Medical Sciences Edvard Antonovich Zhavrid, manager of a department, Doctor of Medical Sciences Professor Igor Grigoryevich Zhakov, director, Candidates of Medical Sciences Vyacheslav Isaakovich Bezruchko, Yuriy Petrovich Istomin, Iosif Iosifovich Malinovskiy, and Tatyana Vladimirovna Khodina, senior scientific associates, Doctor of Medical Sciences Professor Semen Zakharovich Fradkin, manager of a laboratory, workers of the same institute; Academician of the Belorussian SSR Academy of Sciences Nikolay Yevseyevich Savchenko, head of a chair of the Minsk State Medical Institute—for the series of works "The Development and Introduction in Practice of Methods of Treating Malignant Tumors With the Use of Hyperthermia and Hyperglycemia."

4. Doctor of Medical Sciences Aleksandr Aleksandrovich Zaporozhets, leading scientific associate of the Institute of Physiology of the Belorussian SSR Academy of Sciences; Doctor of Medical Sciences Professor Aleksandr Vladimirovich Shott, head of a chair of the Minsk State

Medical Institute; Candidates of Medical Sciences Viktor Yulyanovich Klintsevich, Valeriy Sergeyevich Kipel, and Vladislav Bronislavovich Strizhevskiy, assistant lecturers of the chair, Doctor of Medical Sciences Yevgeniy Nikolayevich Petrovich (posthumously), former docent, workers of the same institute; Candidate of Medical Sciences Petr Kuzmich Zagniboroda, docent of the Vinnitsa Medical Institute imeni N.I. Pirogov; Aleksandr Pavlovich Vasilevich, physician-surgeon of the 10th Clinical Hospital of Minsk—for a series of works on the theory of the intestinal suture and the genesis of bacterial complications after operations on the gastrointestinal tract, which were published in 1962-1986, and the development on this basis of new effective methods of preventing these complications.

5. Doctor of Philological Sciences Professor Vladimir Vasilyevich Anichenko, head of a chair of Gomel State University imeni Francisco Skorina—for the series of works "Skoriniana," which were published in 1966-1987.

In Technology

1. Corresponding Member of the Belorussian SSR Academy of Sciences Mikhail Nikolayevich Bodyako, senior scientific associate-consultant of the Physical Technical Institute of the Belorussian SSR Academy of Sciences; Doctor of Technical Sciences Anatoliy Illarionovich Gordiyenko, head of a laboratory, Candidates of Technical Sciences Viktor Viktorovich Ivashko and Aleksandr Semenovich Dymovskiy, senior scientific associates, workers of the same institute; Georgiy Alekseyevich Semenyuk, chief project designer of the special design and technological bureau with a pilot works of the Physical Technical Institute of the Belorussian SSR Academy of Sciences; Vasiliy Semenovich Zhukovets, electrician of the same bureau; Candidate of Technical Sciences Boris Dmitriyevich Chukhin, chief of a department, Candidate of Technical Sciences Eleonora Nikolayevna Petrova, chief of a sector, Viktor Petrovich Yankov, scientific associate, Yuriy Iosifovich Belkin, leading engineer, workers of the same institute—for the development of the theory, technology, and equipment for the obtaining of heterogeneous materials by the methods of electrothermics and the organization of the series production of these materials.

2. Nikolay Dmitriyevich Busel, director of the Borisov Plant of Automobile and Tractor Electrical Equipment imeni 60-letiya Velikogo Oktyabrya; Vladimir Yefimovich Karpman, chief of a shop, Anatoliy Yemelyanovich Reut, leader of a brigade of grinders, Viktor Bronislavovich Stankevich, chief of a technological bureau of a shop, Sergey Iosifovich Khvatik, chief of a shop, workers of the same plant; Candidate of Technical Sciences Aleksandr Viktorovich Alifanov, scientific secretary of the Physical Technical Institute of the Belorussian SSR Academy of Sciences; Candidates of Technical Sciences Aleksey Vladimirovich Belyy and Tatyana Valeryanovna Kalinovskaya, senior scientific associates, workers of the same institute; Candidate of Technical Sciences Leonid Dmitriyevich Olenin, head of a department of the Scientific Production Association of Automobile Electronics of the USSR Ministry of Automotive and Agricultural Machine Building; Leonard Vatslavovich Zakharevich, manager of the state acceptance organ at the Borisov Plant of Automobile and Tractor Electrical Equipment imeni 60-letiya Velikogo Oktyabrya—for the study, development, and introduction of advanced low-waste technological processes of cold die forging and the organization of the highly profitable mass production of parts of automobile and tractor machine building.

For Textbooks

Doctor of Technical Sciences Professor Stanislav Stanislavovich Shushkevich, head of a chair of the Belorussian State University imeni V.I. Lenin; Candidate of Physical Mathematical Sciences Mikhail Konstantinovich Yefimchik, docent of Gomel State University imeni Francisco Skorina—for the textbook for higher educational institutions "Osnovy radioelektroniki" [The Fundamentals of Radio Electronics], which was published in 1986.

[Signed] Secretary of the Central Committee of the Communist Party of Belorussia Ye. Sokolov

Chairman of the Belorussian SSR Council of Ministers M. Kovalev

BSSR Awards Prizes for Achievements in S&T

18140159 Minsk SOVETSKAYA BELORUSSIYA in Russian 5 Jan 89 p 3

[Article by President of the Belorussian SSR Academy of Sciences V. Platonov, chairman of the Committee for Belorussian SSR State Prizes in Science and Technology (BELTA): "On the Way to the World Level"]

[Text] The awarding by the Belorussian CP Central Committee and the republic Council of Ministers of the 1988 Belorussian SSR State Prizes in Science and Technology was a high rating of the contribution of Belorussian scientists to the development of science. The determination of the winners took place in an atmosphere of great demandingness, and already at the first stage when selecting the works we enlisted not only authoritative specialists from the republic, but also leading scientists of the country. Such an approach ensured, first of all, the making of high demands on the works, which were submitted for the award, and objectivity in the evaluation of their level.

The series of works of Doctor of Philological Sciences V.V. Anichenko "Skoriniana," which includes "Slownik movy Skaryny" [Dictionary of the Language of Skorina] in 2 volumes and 12 scientific publications in republic, all-union, and international printed publications, was commended with the award. The dictionary contains lexical material which clearly shows what levels of Skorina's language have been preserved in Belorussian to the

present. It makes it possible to determine more reliably the role of Skorina in the formation of the language of the Belorussian nationality and in the specification of the most important stages of its development. Not only is the lexicon of Skorina and his age systematized for the first time, but everything incomprehensible in his texts is explained. In addition to the scientific function, the dictionary also performs a cultural function as a monument of the history of the people.

The lofty award was conferred on Doctor of Physical Mathematical Sciences A.A. Bogush and Candidate of Physical Mathematical Sciences L.G. Moroz for the series of works "The Classical Field Theory of Elementary Particles." The authors on the basis of the development and use of covariant (group theory and algebraic) methods and the development of a general theory of free and interacting classical fields in both a conventional and a matrix formulation gave a consistent description of the electromagnetic and weak (electroweak) interactions of elementary particles. The properties and laws of the interaction of particles (proton, neutron, and deutron), which have a complex structure, were studied. The materials of the research found application in scientific research and educational practice in the republic and outside it.

A collective of authors from the Institute of Bioorganic Chemistry of the Academy of Sciences was awarded the prize for the development of the scientific principles, the development of the technology, the organization of the pilot production, and the introduction in health care practice of X-ray diagnostic sets.

In conformity with the social order of medicine specimens of the most important diagnostic aids for the monitoring of the activity of glands of internal secretion and the state of the cardiovascular, immune, and reproductive systems, for the identification of oncological diseases, and for the monitoring of the effectiveness of their treatment were produced at the pilot works of the institute. The authors developed new effective methods and technological processes of obtaining 125 biologically active synthetic and natural substances of biochemical preparations—the components of x-ray diagnostic systems, studied the molecular mechanisms of immunochemical reactions, and developed 23 types of x-ray diagnostic sets for the medical microanalysis of several hormones, proteins, and tumor markers.

For the first time in the USSR a biotechnology of the production of x-ray diagnostic sets was developed and their series output in amounts, which meet the needs of domestic health care, was organized. The x-ray diagnostic sets, which are being produced by the pilot works of the institute, are being delivered to 130 cities of all republics of the country, to CEMA member countries, and to several capitalist countries.

The Belorussian SSR State Prize in medicine was awarded to a large authors' collective of oncologists for a series of works on the development and introduction in practice of methods of treating malignant tumors with the use of hyperthermia and hyperglycemia. The authors substantiated experimentally and introduced in practice methods of increasing the effectiveness of the treatment of malignant tumors by the combined use of thermal effects with radiation and drug therapy. These methods were introduced in the practice of work of 19 oncological centers. The series of works, which was also commended with the prize, on the theory of the intestinal suture and the occurrence of bacterial complications after operations on the gastrointestinal tract and on the development on this basis of new effective methods of their prevention is also of just as great importance.

State prizes were also awarded to works, which solve urgent problems of technical progress.

A creative group of specialists of the Physical Technical Institute of the Belorussian SSR Academy of Sciences and the special design and technological bureau with a pilot works of this institute developed the theory, technology, and equipment for obtaining heterogeneous materials by the methods of electrothermics and organized their series production. The development of new models of equipment involves the solution of the problems of obtaining materials with a high specific strength. The process of the surface electrothermal hardening of titanium alloys, which is based on the phase transitions that occur in alloys upon rapid heating, proved to be most promising for this goal. The economic impact from the introduction of these materials due to the decrease of expenditures came to more than 10 million rubles. There are no analogous developments in the world.

A collective of authors, which is engaged in the study, development, and introduction of advanced low-waste technological processes of cold die forging and the organization of the highly profitable mass production of parts of automobile and tractor machine building, was awarded the prize. In this work, which was submitted by the Borisov Plant of Automobile and Tractor Electrical Equipment imeni 60-letiya Velikogo Oktyabrya, the mechanics of the processes and operations of cold die forging was developed on the basis of the theory of slip lines, the theory of transition regions, and the generalization of the theory of processes of extrusion with the application of additional loads.

Cold die forging has become one of the most advanced modern resource-saving technologies. It makes it possible to reduce to a minimum the discharge of metal in chips, to increase the quality of items and labor productivity, and to ensure a high level of the automation and mechanization of technological processes. The engineering analysis of the results of scientific research at the Borisov Plant of Automobile and Tractor Electrical Equipment imeni 60-letiya Velikogo Oktyabrya made it possible to develop highly efficient methods of cold die forging and new types of dies.

The high award was conferred on Doctor of Technical Sciences S.S. Shushkevich and Candidate of Physical Mathematical Sciences M.K. Yefimchik for the textbook for higher educational institutions "Osnovy radioelektroniki" [The Fundamentals of Radio Electronics], which was published in 1986. The textbook is intended for undergraduates of natural science specialties of universities and is based on the concept, which was developed by the authors, of the teaching of radio electronics with the continuous connection of lecture and laboratory instruction. Procedural recommendations on the organization of practical laboratory work are also included in the book, a description of laboratory equipment is given. The textbook reflects the state, level, and trends of modern radio electronics.

In conclusion I would like to heartily congratulate the new winners of the Belorussian SSR State Prize on the great joyful event in their life and to wish them new creative accomplishments for the good of our homeland.

Determination of Prices for S&T Developments Examined

18140162c Moscow PLANOVOYE KHOZYAYSTVO in Russian No 1, Jan 89 pp 64-68

[Article by Candidate of Economic Sciences T. Nechay under the rubric "Scientific and Technical Progress" (Kiev): "The Formation of the Prices for Developments of New Equipment"]

[Text] The intensification of the economy is possible in case of the comprehensive improvement of the economic mechanism of the management of social production and in case of truly cost accounting relations between the participants in the process of the preparation, development, and use of new equipment and technology. The scientific substantiation of the methods and practice of determining the prices for the final results of scientific, technical, and production activity is acquiring particular importance. In other words, it is necessary to examine in interconnection and interdependence the entire system of pricing (beginning with the product of research and development and ending with the product that is produced by means of new equipment) as a unified whole, as the basis for the organization of strictly equivalent relations between scientific organizations and enterprises. The urgency of such an approach is also being increased by the fact that the effectiveness of labor is becoming the main indicator of the work of collectives and the basic source of the production of their income, which forms all types of funds. The amount of income is being made directly dependent on the efficiency of the labor of the participants in the process of the development and use of new equipment.

The development of the methodology of establishing the prices for the scientific and the planning and design product, which are based on the result of labor, and their practical implementation are playing a substantial role in the solution of economic problems. The possibilities of the establishment and efficient functioning of an economic mechanism of the management of scientific and technical progress in many respects depend on the sound formation of prices.

Scientific and technical developments are unique products, which differ substantially from all other products that have been materialized as objects and tools of labor. The main peculiarity consists in the creative activity of their developers, who ensure the increase of production efficiency and the productivity of national labor. Specialists have calculated that about 80 percent of the future economic impact of new equipment is formed at the stage of research and development. The especially great importance of the economic results of scientific research institutes and the necessity of their consideration (but not the expenditures) in the practice of determining the prices for scientific products are due to this. Meanwhile, the latter continue to be established on an expenditure basis. Even at the Sumy Scientific Production Association imeni M.V. Frunze and at AvtoVAZ, which were the first in the country to begin assimilating the new economic mechanism, the pricing of scientific and technical developments is not in keeping with principles of cost accounting.

One of the reasons for the expenditure method is that the economic impact has not yet been accepted in the capacity of the basic result of the activity of scientific research institutes as the ultimate goal of the planning, designing, and production of new equipment, but is calculated only as an incidental result. This has the result that the organizations, which are engaged in the development of new machines and equipment, are not directing their attention to the increase of production efficiency as the basic goal of their work. While the system of planning, stimulation, and pricing justifies nearly any of their expenditures. Under the conditions of cost accounting such a method of determining prices is unacceptable.

The introduction of cost accounting in all spheres of the activity of labor collectives and the increase of the influence of the results of labor on economic indicators require the radical improvement of the system of pricing of research and development and the transition from the expenditure principle to the effectiveness principle. It would not be an exaggeration to say that in the establishment of the economic mechanism of the management of scientific and technical progress the problem of prices is one of the most urgent and, at the same time, least elaborated problems.

The methods of pricing as applied to the scientific product have not yet received the necessary elucidation. The prices, at which it is sold, are determined everywhere by the estimate of the expenditures on its development. In establishing the cost of research and development in machine building sectors, as a rule, they use the following approach: to the cost of the work they add the profit, which is calculated as a percent of different bases—the production cost, the wage, the economic impact that has been derived from the introduction of the given design. This is, in essence, a modification of the expenditure method, when they add to the costs in the form of the profit a portion of the economic impact.

A search is being made for new, more effective means of improving the pricing of scientific developments. One of the methods of determining the price is based on the "value reassessment" of the made expenditures by a portion of the economic impact that forms sectorial accumulations. Another method envisages the addition to the expenditures of the profit, which has been calculated in proportion to the wage, as well as the additional profit that was derived in case of the introduction of research and development.

The experience of the CEMA member countries in determining the prices for scientific and technical developments is of interest. But in foreign practice a unified view of the objective basis of the price has also not yet been formed. At times the economic results of creative work are interpreted as capital, which yields income in the form of an economic impact. The price is defined as a part of the impact which has been adjusted by the norm of the increase of capital in industry. In other cases it is calculated on the basis of the revenue from the sale of the scientific and technical product less internal expenses. Each CEMA member country has its own distinctive peculiarities in the use of this method.

In recent years in Hungary, the GDR, Poland, the CSSR, and Bulgaria they have begun to form the prices for the scientific product on the basis of the principles of the more complete consideration of the results of labor.

The technical and economic level (TEU) of new items is directly connected with the price of scientific developments. The former in the end also predetermines its amount, since the more advanced and economically effective an innovation is and the greater value it has for the consumer, the higher its price can be.

Before establishing the prices for scientific and technical developments, it is important to determine their technical and economic level, inasmuch as it is possible to accept for designing and subsequent production only that product, the technical and economic level of which surpasses the parameters of the best available equipment and technology.

The method of calculating the technical and economic level of planned equipment, just as operating equipment, should be formed so that it would be possible to evaluate the progressiveness of the consumer properties of the item and its economic value for the consumer. From this standpoint it seems to us that the technical and economic level of the scientific and technical product should be defined as the ratio of the total economic impact (which is created at the scientific research institute, the design bureau, for the producer, and for the consumer and is intended for the period of its use up to obsolescence) to the technical parameter of the item, which has been selected as the basic one. The comparison of the technical and economic level of equipment being planned for development and the best models of domestic or world equipment (if possible, in the long-range period) will make it possible at the earliest stages of the preparation of production to establish the advisability of the development of an innovation. For the greater persuasiveness and reliability of the calculations in case of such a comparison it is expedient to specify in advance the standards of the technical and economic level, which are determined by the advanced technical characteristics of future machines and by the indicators of the saving in case of the comparative evaluation of the technical and economic level of scientific ideas which are intended for development. If the technical and economic level of the scientific product is higher than the standard level, it will be considered promising and economical, otherwise it will be considered obsolete.

It is important to calculate the indices of individual indicators for the future, as well as the technical and economic level of items in dynamics. If it turns out that for any reasons it is not possible for the present to develop new, sufficiently advanced, and economically effective equipment, the versions are examined and the possibilities of the purchase abroad of licenses for its production are evaluated.

Taking into account the particular importance of speeding up the interchangeability of machines and increasing their efficiency, the USSR Council of Ministers in December 1986 approved a statute on the cost accounting foreign trade firm of the scientific production association, enterprise, and organization, which grants extensive independence to the developers of new equipment in the settlement of economic questions in the area of the exporting and importing of industrial products, as well as license trade. The broadening of the rights of enterprises and organizations on the foreign market makes them responsible for the economical spending of assets in foreign currency. The use of internal currency funds under the conditions of self-financing, the changeover to the currency self-support [samookupayemost] of the research and development that are being conducted, the increase of the turnovers of such goods as the scientific and technical product, licenses, and patents—all this requires the increase of the scientific soundness of their prices, on the basis of utility and economic effectiveness.

When establishing the prices for licenses it is important to take into account the time factor for the entire cycle—from the development to the introduction and use of new equipment—since the speed of the implementation of a design directly influences the efficiency of an item. It seems that the price of a license (as a version of the scientific and technical product) should be formed directly subject to the amount of the economic impact, which was obtained from the implementation of the innovation at the consumer's place over the entire period of its operation until obsolescence with allowance made for all spheres of use.

In light of what has been said the urgency of the scientific soundness of the methods of determining the prices for the results of scientific, technical, and production activity, which have been completed and are being turned over to the consumer, is acquiring great importance. How are the prices for developments to be formed.

A characteristic of creative scientific and technical work is that the necessary and surplus labor are not directly interconnected. Quite substantial results for society can be achieved by negligible labor expenditures, and, on the contrary, the great efforts of scientists, planners, and designers can yield modest fruits. In other words, the

value and significance of their results are determined not by the expenditures, but first of all by the effectiveness of developments.

Inasmuch as scientific, technical, and production collectives (the scientific research institute, the design bureau, the pilot and series-producing plants, the user enterprise) participate in the process of developing a new item and the economic impact as the ultimate goal is formed by them jointly, when determining the prices for all types of products (both the intermediate and the final product) it is necessary to distinguish the share of each of them in the obtained economic result. On the basis of the foregoing the procedural principles of forming the prices for scientific and technical developments are seen in the following.

The formation of prices at the intersectorial level, on the basis of the unity and interconnection of the process of developing new types of products—starting with development and ending with the use of equipment by the consumer—is a peculiarity of pricing under the conditions of full cost accounting. Its total economic impact is regarded as the result of the joint creative activity of scientific research institutes and enterprises and of those belonging to each of them in the part which they created. When distributing the total economic impact among all the coperformers and by stages, they establish the earned part of the impact, which belongs to each collective.

Thus, the **effectiveness principle** can be made the basis of the price for the scientific and technical product. The price for each of the developers in each specific case is calculated with the objective consideration of the share of the impact, which was provided by the creative contribution of the scientific research institute in the overall economic impact with respect to one object or another of new equipment and technology.

One of the means of calculating the proportionate economic impact is its determination in proportion to the wage of personnel with a correction factor, which evaluates the creative nature of labor, which is recognized as most efficient. The coefficient of creative participation is calculated by the expert means. Experience of such evaluation exists in industry (for example, in shipbuilding). The coefficient can be used with respect to both each scientific and technical job and the collective as a whole. This indicator makes it possible to reliably take into account the efficiency of the labor of all those participating in the development of a scientific and technical innovation.

The increase of the economic impact signifies the increase of the utility of developments for their users. The level of the price for a development should reflect the increase of the efficiency of the production of a product. The increase of efficiency can be controlled by the improvement of the consumer properties of the product and by the relative decrease of the cost of a unit of the consumer properties of new items. The price, which has been formed in this way, at the same time also performs the function of an evaluation of the efficiency of the activity of scientific research institutes.

A scientific and technical development can be sold repeatedly. Its price is calculated for the specific consumer, reflects the production conditions of the latter, and for this reason is individual. Here the series nature of the production of new items on the basis of a new development is of great importance. The greater it is, the larger amount of the economic impact will be realized and the greater the relative decrease of the cost of a unit of the final product is.

In domestic practice the first steps on the selling of scientific developments on the free market were taken at the trade fair of scientific and technical ideas in Kishinev in 1986. In all 50 orders each were received for some of the 400 displayed designs of innovations. In 1987 an exhibition and sale of 5,000 developments, of which 87 percent have world novelty and were confirmed by inventor's certificates, was organized at the Exhibition of USSR National Economic Achievements.

At the same time about 150 interesting innovations were displayed at an auction of ideas in Nizhnevartovsk of Tyumen Oblast, many of which were purchased and will be used in production. The free choice of drawings, scientific and technical ideas, and developments and the possibility of their purchase for subsequent introduction in industrial production were made available to the buyers.

The same developments can be carried out by several organizations simultaneously on the basis of the principles of competitive selection. The best, most advanced and economical ones of them will receive public recognition, will have broad marketing, and will supplant less successful ones. The scientific and technical product can be sold to organizations needing it by installments on the terms of credit with interest. In case of the described methodological approach both the developer and the consumer are interested in its maximum effectiveness. The former is, because he will derive the largest profit in case of the greatest impact and, hence, will form the necessary funds. The later will be able to save resources as much as possible in case of the implementation of the design by means of the relative increase of the effectiveness of a unit of the consumer property.

The extent of the introduction of research and development influences the amount of the price of new equipment and technology: the broader the sphere of introduction is, other things being equal the lower the price of the latter is, inasmuch as the cost of scientific and technical developments is included in it.

It is necessary to carry out the monitoring of the effectiveness and technical and economic level of research and development at all successive stages of the scientific and technical analysis, production, and operation of

equipment. The managers of the scientific research institutes and enterprises, which are taking part in the development of new models of equipment, technology, and materials, should bear material liability for the validity and reliability of the prices that are submitted for payment.

The implementation of the stated methodological approaches to the pricing of scientific and technical developments will be able to ensure:

— the economic interest of scientific, planning and design, and technological organizations in the development of a highly efficient, fundamentally new product that surpasses in its parameters the best domestic and world models;

— the stimulation of the user of new equipment in its utilization for the increase of the efficiency of his own production by the decrease of expenditures and the derivation of the maximum profit on the basis of significantly improved technical, production, and operating characteristics;

— the one-time calculation of the saving of expenditures of national labor in contrast to other means of evaluation, which will increase the objectivity and soundness of the indicator of the economic impact;

— the strengthening of cost accounting principles by the economic interest of all the developers of a new product in the improvement of the results of their own labor and the achievement on this basis of the best indicators of the scientific and technical level of items and the productivity of national labor.

The proposed methodological principles of the formation of prices on the effectiveness basis can contribute to:

— the increase of the responsibility of scientific research institutes and enterprises for the elaboration of effective technical solutions, which surpass the best achievements of domestic and world science and technology and make it possible to increase as much as possible the technical and economic level of items and their effectiveness;

— the selection of the most advanced versions of a new product on the basis of the determination of the technical and economic level of the new equipment, technology, and materials, which are accepted for subsequent development;

— the timely, scientifically substantiated determination of the prices for the scientific and technical product, which is being produced by organizations, enterprises, and associations of machine building sectors under the conditions of full cost accounting;

— the evaluation of the efficiency of the activity of scientific research institutes and enterprises, which are engaged in the development, assimilation, and introduction of a given type of equipment;

— the strengthening in the area of pricing of the cost accounting principles of the scientific, technical, and production collectives which are developing new equipment, technology, and materials.

Statistics on S&T Manpower, Expenditures Analyzed

18140162a Moscow PLANOVOYE KHOZYAYSTVO in Russian No 1, Jan 89 pp 46-55

[Article by Candidate of Economic Sciences R. Kozhevnikov under the rubric "Scientific and Technical Progress": "The Development of the Scientific and Technical Potential Under the Conditions of Cost Accounting Management"]

[Text] At the present stage of the scientific and technical revolution the role of science is increasing. It is turning into the most important factor of economic and social progress, which in many respects determines the degree of satisfaction of the material and social needs of society. The new socioeconomic function has formed science into a special sector of social production, which is characterized by the significant scale and the great dynamism of the development of its potential (see Tables 1, 2).

Table 1

Indicator	1950	1960	1970	1975	1980	1985	1987
Spending on science from state budget and other sources, billions of rubles	1.0	3.9	11.7	17.4	22.3	28.6	32.5
as a percent of the national income	1.8	2.7	4.0	4.8	4.8	5.0	5.5
Number of personnel in the sector of science and scientific service, thousands	714	1763	2999	3790	4379	4554	4369
as a percent of the total number of workers and employees	1.7	2.8	3.3	3.7	3.9	3.9	3.7

Table 2 (in percent)

Indicator	1951-1960	1961-1970	1971-1975	1976-1980	1981-1985	1986-1987
Growth rate of						
Gross national product						
for the period	156.0	95.0	36.0	23.0	19.0	7.0
average per year	9.9	6.9	6.3	4.2	3.5	3.5
Produced national income						
for the period	161.0	100.0	32.0	24.0	19.0	6.0
average per year	10.1	7.2	5.7	4.4	3.5	3.0
Spending on science						
for the period	290.0	200.0	48.7	28.1	28.2	13.6
average per year	14.6	11.6	8.2	5.1	5.1	6.6
Number of personnel in the sector "science and scientific service"						
for the period	146.9	24.9	26.4	15.5	4.0	-4.1
average per year	9.5	4.5	4.8	2.9	0.8	-2.0

The cited data make it possible to distinguish a number of trends that are important for the evaluation of the present state of science and technology and their role and place in the economy of the country. This ultimately is the starting point for the elaboration of a general concept of the improvement of the economic management of scientific and technical activity.

The ratio of the growth rates of the amounts of financing and the number of people employed in the sphere of science and scientific service testifies to the substantial slowing of the influx of manpower resources, the growth of the share of embodied labor in the total expenditures on science, and the increase of the technical equipment of scientific research institutes. Here the increase of allocations, as well as of the contingent of people working in this sector leads the basic indicators of the economy of the country, which reflects the rapid development of science-intensive industries and is responsible for the overall increase of the science-intensiveness of the national economy.

However, during the period in question the dynamics of the increase of resources for scientific and technical activity and its correlation with the growth of the gross national product and the national income are of a diverse nature. In accordance with these attributes in the development of the scientific and technical potential it is possible to distinguish the period of the 1950's through the first half of the 1970's, which was notable for the absolute and relative increase of resources, and the period from the second half of the 1970's through the 1980's, including the current five-year plan, which is characterized by the absolute increase of resources with the stabilization of the rate of their increase and their share in the national income, as well as the total number of workers and employees in the national economy.

The first of them has a pronounced extensive nature of development, which reflects the conditions of the increase of the scientific and technical potential. The solution of problems, first of all by the increase of the number of people employed and a high growth rate of the total allocations for science, is characteristic of this period.

The second period contains attributes of intensive development, when problems are realized on the basis of the more complete use of the previously accumulated scientific and technical potential, for which all the factors, which are conducive to the intensification of the processes of research and development and the increase of their effectiveness, should be put to use.

The named trends have an analogy in a retrospective view of the development of science in a number of foreign countries. Thus, in the United States, Great Britain, and the FRG with an absolute increase of the allocations for scientific research and development since the early 1970's there has been observed a stabilization of the share of the expenditures on research and development in the gross national product, which in the middle of the 1980's remained at the level of 2.2-2.7 percent. This testifies to a shift from the extensive development of the scientific and technical potential to the more widespread use of intensive factors. In the majority of socialist countries until the early 1970's the extensive growth of the expenditures on science was also observed. In the GDR and the CSSR, starting in the middle of the 1970's, their share in the national income (at the level of about 4 percent) stabilized.

Intensive or extensive development is not accomplished in pure form. Obviously, the evaluation of the primarily intensive or the primarily extensive means is more legitimate. And in the next few years scientific and technical activity can still be developed by means of extensive factors, that is, the increase of the amounts of the allocations for science and an additional contingent of workers. During the current five-year plan, for example, the financial assets being allocated for basic research are being increased significantly. In 1989, an increase of

state budget allocations by 132.4 percent is envisaged for these purposes as compared with the preceding year. But along with extensive factors intensive factors, which ensure the solution of scientific and technical problems by the more efficient use of the scientific and technical potential and the mobilization of its internal possibilities and reserves, are playing a larger and larger role.

The problem of intensification, of course, is not limited to the estimation of the scale of the financial, manpower, material, and technical resources, which have been put to use, and to the rate of their increase. As applied to the scientific and technical potential the intensive stage of its development should be accompanied by the leading growth of the amount of research and development with respect to the expenditures of living and embodied labor, by the increase of the scientific, technical, and economic level of the end results of activity, and by the shortening of the time of the implementation of innovations. With allowance made for these parameters, let us analyze the indicators of the development of the scientific and technical potential in recent years.

For all the conditionality of the expenditure approach to the measurement of the amount of research and development being performed, the dynamics of such an indicator, which is compared with the number of workers, gives some estimate of the degree of intensive use of the scientific and technical potential. The change of the base index of the spending on science per employed person is characterized by the following data: 1970—1, 1975—1.17, 1980—1.3, and 1987—1.9. The same indicator in several capitalist countries is also increasing, but at a slower pace: the similarly calculated base index came in the United States to 1.16, the FRG—1.26, and France—1.5.

While noting the favorable trend of this indicator, one should bear in mind its local nature as applied to the overall problem of the intensification of the use of the scientific and technical potential, which envisages the evaluation of efficiency with allowance made for all the stages of the innovation process. In this connection the value measurement of the specific amounts of work, which were performed at the stage of research and development, should be supplemented by data on the end scientific and technical results, which were obtained in the process of developing and using new equipment. It is possible to characterize them, in particular, by the scale of the assimilation of new types of products, as well as the use of inventions and efficiency proposals (see Table 3).

Table 3

Indicator	1971-1975	1976-1980	1981-1985	1986	1987
Number of descriptions of assimilated new types of industrial products, total					
for the period	16595	17523	19253	4089	4199
average per year	3319	3514	3851		
Including:					
machines, equipment, apparatus, instruments, automation equipment, and items of machine building					
for the period	13286	13727	15009	3395	3464
average per year	2657	2745	3134		
materials and products					
for the period	3309	3796	3584	674	735
average per year	662	759	717		
Number of inventions and efficiency proposals used for the first time, millions					
for the period	18.6	20.1	20.0	4.0	3.9
average per year	3.7	4.0	4.0		

The cited data confirm that during the period in question the problem of implementing intensive factors was not completely solved. The increase of the assimilation of new types of industrial products is negligible, while the level of use of inventions and efficiency proposals in practice stabilized. The data on the expenditures on measures on new equipment and the economic effectiveness of their introduction confirm these conclusions (see Table 4).

Table 4

Indicator	1971-1975	1976-1980	1981-1985 Total	1981-1985 Including 1985	1986	1987
Actual expenditures, billions of rubles	31.0	43.4	56.1	12.2	13.5	13.2
Number of conditionally released personnel, thousands	2646	2790	2510	546	604	603
Increase of profit, total, billions of rubles	8.8	13.1	16.2	3.9	4.5	4.8
per ruble of expenditures on introduction, ruble	0.28	0.30	0.29	0.32	0.33	0.36
Annual economic impact, total, billions of rubles	16.8	21.8	25.7	6.0	6.2	6.3
per ruble of expenditures, ruble	0.54	0.50	0.45	0.49	0.46	0.48

The dynamics of the indicators of the saving of living labor, the increase of the profit, and the economic impact per ruble of expenditures, which were achieved due to the introduction of scientific and technical measures, is unstable, while as a whole during the 11th Five-Year Plan it tends to decrease. This gives rise to the necessity of the more careful analysis of the factors, which determine the effectiveness of the use of the scientific and technical potential and the degree to which the reserves of intensification are put to use.

In our opinion, it is possible to reduce the set of factors, which influence intensification, to three basic groups. The first of them is connected with the use of personnel. The achieved level of development of science and technology and the prospects of its further growth are making great demands on the skills of the people employed in this sphere. The personnel component, along with the total number of workers, is also governed by sound proportions in their breakdown by specialization and sectors of the national economy, by the optimum ratio of scientists and other personnel, and so on.

The second group unites the factors of the technical equipment of labor. The latter intensifies activity first of all by means of specific tools of scientific labor (advanced information retrieval systems, high-precision instruments and recording devices, diagnostic equipment, means of the automation of experiments and designing, and others). The capital-labor ratio with respect to traditional means of production, the level of their replacement, the development of the capacities of pilot experimental production, and so on should be evaluated together with them.

And, finally, the third group of factors is cost accounting factors, the essence and use of which consist in the creation of conditions which ensure the influence of economic, financial and credit, and organizational planning levers and stimuli on the most complete use of the scientific and technical potential.

As for this group of factors, during the period in question a set of steps on the changeover to the cost accounting organization of work on the development of new equipment was prepared and taken. It is possible to characterize the basic attributes of such organization in the established system of the management of scientific and technical activity in the following manner:

— in the area of planning, the introduction of the supply order—a comprehensive organizational planning document, which links all the stages of the development of new equipment, as well as the end results of the work with the resources necessary for its fulfillment;

— in the area of financing, the formation from the profit of industrial enterprises (associations) of sectorial funds of the development of science and technology as the basic source of financing of such work;

— in the area of economic stimulation, the formation at the place of the immediate developers of new equipment of independent incentive funds, which are created by means of the actual economic impact in the form of the saving from the decrease of the product cost, which is ensured by the introduction of innovations, or the additional profit from the sale of new highly efficient items.

As a whole these innovations are progressive. They confirm the potentialities of the development of the cost accounting organization of work in the sphere of research and development. However, their implementation was limited by the imbalance of the centralized and decentralized spheres of the management of science, by the poor economic interest of the participants in the development and introduction of new equipment, and by their inadequate mutual cost accounting liability for the end results of work.

For the elimination of such limitations and the introduction of real cost accounting scientific research, planning, design, and technological organizations were converted to new methods of management. This ensures the adequacy of the economic mechanism in science to the general concept of the restructuring of the management of the economy on the terms of full cost accounting and self-financing and the increase of the independence of the basic production unit.

To what do the basic changes in the principles of the activity of scientific research institutes, which contribute

to the increase of the influence of cost accounting levers on the efficiency of the use of the scientific and technical potential, reduce?

Scientific organizations are becoming an equal participant in commodity-money relations in the process of the development and introduction of new equipment. They perform all jobs only in accordance with contracts with clients, including the superior organ of management. The contract contains the terms of the acceptance by the client of the completed job, which receives the status of commodity production, here the mutual economic liability for the breach of obligations is specified.

The changeover to the special-purpose financing of research and development in accordance with contracts with interested clients instead of the financing of the maintenance of organizations is envisaged. This means that the internal assets of enterprises and associations should be the basic source of financing, while financial levers and stimuli are becoming one of the main directions of the introduction of the cost accounting mechanism in science.

The new principles of management are changing radically the original conditions of the economic stimulation of scientific research institutes. They presume the formation of the corresponding economic stimulation funds directly at the expense of the profit that has been derived from the sale of the scientific and technical product to the consumer. Thus, the profit not only reflects the end economic result of work, but also acts as the basic source of the material stimulation of the collective, as well as the scientific, technical, and social development of organizations.

The cost accounting mechanism in science in recent times has been discussed extensively in economic literature. Therefore, when evaluating the effect of cost accounting levers and stimuli let us confine ourselves to those of them, which are directly connected with the peculiarities of the present stage of the development of the scientific and technical potential and with the above-noted factors of its intensification, that is, with the more efficient use of personnel and the increase of the technical equipment of scientific labor.

The manpower resources of science act as the immediate subject of scientific activity. Its specific nature and difference, for example, from industrial activity consist in the fact that living labor as the aggregate of the labor participation of specialists of various categories—researchers, designers, process engineers, testers, and workers of pilot production—performs the main role in it. Precisely for this reason the problem of intensification should be examined first of all from the standpoint of the increase of the efficiency of their labor and all the factors that determine its effectiveness.

As was already noted, the increase of the people employed in the sphere of science and scientific service leads the overall increase of the number of workers and employees in the national economy. The share of working people, who are directly connected with the process of research and development, is increasing. Thus, in 1986 the share of scientific personnel in the total contingent of people employed in this sector came to 33 percent as against 30.9 percent in 1970. In this group the number of working people, who have an academic degree, is increasing at a leading rate. At the end of 1986 there were 46,000 doctors of science and 473,000 candidates of sciences, which constituted respectively 3.1 and 31.4 percent of the total number of scientific personnel. The comparison of analogous indicators on the size of such a contingent in the USSR and the United States testifies to their approximately equality.

The analysis of their breakdown by fields of sciences shows that the basic directions of scientific activity are provided with personnel. Here nearly half (48 percent) of the scientific personnel of the country are concentrated in the technical sciences, while about a fourth are concentrated in the social sciences and the humanities. At the same time the inadequate personnel potential of a number of priority directions of science is being noted. First of all biology, sociology, and the mathematical and computer sciences are among such directions.

In recent years the increase of the number of scientific personnel, including those having academic degrees, has slowed somewhat, which is mainly due to the increase of the demands on the quality of the training and certification of scientific personnel, as well as to the increase of the skills qualification. At the same time the slowdown reflects one of the important problems that have arisen in recent times in the reproduction of scientific personnel, which is connected with their aging. Thus, during 1972-1982 the aging occurred due to the decrease of the share of the 30-40 age group, the proportion of which during this period declined from 46.3 to 33.1 percent. Here the share of doctors of sciences up to the age of 40 decreased to one-third, while the share of candidates of sciences decreased to almost one-half. In contrast to other sectors of the national economy the danger of the aging of scientific collectives is connected not only with the decrease of the productivity of research and development, but also with the possibility of the loss of the continuity of knowledge in individual scientific disciplines.

In case of the analysis of the breakdown of scientific personnel by individual national economic complexes it turned out that given the relative stability of the structure of the scientific potential of the country the share of machine building increased with the simultaneous decrease of the share of metallurgy, which reflects the present trends of development of these complexes. The emerged decrease of the share of sectorial science of the wood chemistry complex should be judged as a disproportion that does not correspond to the overall trend of development of the science-intensive sectors. In the United States, for example, the share of the chemical,

petrochemical, industrial rubber, and pharmaceutical sectors in the total scientific potential of the processing industry comes to about 15 percent and is tending to increase.

In connection with the noted trends of development of the personnel component of the scientific and technical potential it is expedient to take a number of steps, which are aimed at the maintenance of its structure at a level that satisfies the present requirements, including the preferential allocation of manpower resources for the priority sectors, the creation of favorable conditions of the rotation of scientific personnel, the improvement of the mechanism of the regulation of their age composition, and others. It is possible to group with the steps, which ensure, in particular, the adequate influx of young people into science, the enlargement of the contingent of graduates of the higher school, who have creative skills (by the strengthening of the connection of the educational process with scientific research work and by the development of various forms of the creative scientific and technical work of youth), as well as the streamlining of the network of higher educational institutions and scientific research institutes, which are permitted to carry out the training of scientific personnel through doctoral studies and graduate studies.

Along with the necessity of implementing organizational planning measures one should also enhance the role of economic levers in the increase of the efficiency of the use of scientific and technical personnel and in the improvement of their structure and vocational training, which ultimately will affect the effectiveness of scientific labor. In this connection the introduction of a fee for manpower resources in science is justified. According to the calculations of scientific research institutes, which have changed over to cost accounting and self-financing since 1 January 1988, the annual deductions of assets in the form of such a fee will come to about 150 million rubles, or 17 percent of the total profit derived from the sale of scientific and technical products. The more efficient use of the people employed, which ensures the decrease of their number and, accordingly, the fee being paid for manpower resources, will make it possible in case of the approved standards of the distribution of the accounting profit to channel half of the saved assets into the material incentive fund for the direct stimulation of personnel.

At the same time the analysis of the standard base, which has been approved for scientific organizations that have changed over to the new conditions of management, shows that this economic lever of increasing the efficiency of the use of manpower resources is being used inadequately. As a rule, the standards of the fee are set as uniform (in the amount of 300 rubles per person) without regard for the peculiarities of the work of individual scientific research institutes. Obviously, the use of such an economic stimulus in the practice of economic management should envisage a differentiated approach to the level of the standard being approved subject to the specific conditions of scientific and technical activity (the availability of the necessary manpower resources in the region, the urgency of the themes being elaborated, the financial status of the organization, and others). This will increase the economic influence on the intensification of scientific labor.

The same requirements should exist in case of the implementation of the decision on the partial reimbursement of the higher school for the outlays on the special-purpose training of specialists, which is conducted in accordance with contracts with ministries. As is known, for the years of the current five-year plan the amounts of reimbursement are determined on the basis of the limits of the number of specialists, who are being assigned to the sector, and the standard of expenditures, which has been established at the level of 3,000 rubles per specialist. The flexible use of this economic lever, which stimulates the preferential development of the priority sectors of science and the optimum ratios of the age characteristics of the scientific contingent, is required so that such deductions would not lose influence on the improvement of the structure of scientific personnel, having gotten into the category of ordinary planned payments.

The enhancement of the role of cost accounting stimuli in the more complete use of the personnel component of the scientific and technical potential involves the increase of the share of the variable portion of the wage of personnel. It is necessary to confirm the right to it by a specific contribution to the development and introduction of scientific and technical innovations and by the improvement of the indicators of the effectiveness and quality of labor. The experience of enterprises and organizations of the Leningrad region, the use of the "Karpov system" at a number of scientific research institutes of Moscow, and others made it possible to take a number of steps on the improvement of the remuneration of labor. In conformity with them the variable portion of the latter should be increased first of all by means of individual salary increments. Such an approach to the strengthening of cost accounting stimuli in the remuneration of labor has to be implemented first of all for designers and process engineers, the content of whose activity makes it possible to use specific criteria of efficiency—the time of the filling of individual orders, the technical level of the engineering decisions being made, the quality of technical specifications, and others. For scientific personnel, whose labor efficiency is evaluated by more general criteria, the variable portion of the wage is increased by means of the substantial expansion of the "spread" of salaries. Such a step at the same time as the increase of the role of certification, in accordance with the results of which not only is a worker promoted or demoted, but his salary can be changed significantly with the retention of functions, increases the influence of cost accounting stimuli on the growth of the output of scientific collectives. In case of the limited range of positions of scientific personnel, which existed, promotion, as a rule, was accompanied by the assignment to

them of administrative duties, which was not always justified. The expansion of the list makes it possible to stimulate creative activity more flexibly.

Let us examine the effect of the factors of the intensification of the use of the scientific and technical potential, which are connected with the capital-labor ratio of scientific labor. In recent years the material and technical base of science has been developed relatively rapidly. By 1986 the amount of fixed capital of the sector "science and scientific service" had reached 40.3 billion rubles. About 70 percent of the capital is concentrated at scientific institutions of the sectors of industry. The analysis of its technological structure shows that in the majority of sectors the share of the active portion of the capital had increased. This in many respects is governed by the increase of the share of expensive electronic computer hardware, which in individual sectors comes to 10-15 percent. The amounts of measuring and regulating instruments and devices and laboratory equipment are also increasing.

In sectorial science the increase of the value of fixed capital, as a rule, significantly led the expansion of the area. Such a relationship testifies to the increase of the specific cost of the latter. The increase of the cost, on the one hand, is connected with the saturation of scientific organizations with computer hardware, measuring instruments, and equipment and, on the other, with the increase of the cost of construction and installation work. The increase of the latter is explained not only by the fact that modern architectural and construction solutions and the use of new construction materials increase the cost of construction. A certain portion of the capital investments was channeled into the improvement of the working conditions of operating scientific institutions. This question is very urgent for the majority of sectors, inasmuch as in them the number of scientific research institutes, which are located, as a rule, in large industrial cities, the laboratory and production buildings of which are obsolete and their architectural and construction level does not satisfy present requirements, is significant.

At the same time a decrease of the growth rate of fixed capital appeared in the development of the material and technical base of science. In average annual terms it came during the 9th Five-Year Plan to 9.5 percent, while during the 11th Five-Year Plan to 7.5 percent. The decrease was most substantial in machine building and the fuel industry. The pace of the reproduction of the fixed capital of science slowed for the same reason: the coefficient of its replacement decreased from 11.6 percent in 1970 to 8.5 percent in 1985. Together with the low coefficients of retirement (1.93 percent in 1986) this will contribute to the obsolescence of fixed capital and the appreciable worsening of its age structure.

Such trends in the development of the material and technical base of science are finding reflection in the dynamics of the indicator of the capital-labor ratio. In spite of the fact that the value of fixed capital per person working in the sector of science and scientific service has increased by more than 2.6-fold (3,430 rubles in 1970 and 8,860 rubles in 1986), its technical equipment is approximately ten twenty-thirds as great as for industry as a whole. According to available data, in the United States the capital-labor ratio per person employed in the sphere of research and development is nearly the same as in industry.

The question of increasing the instrument-labor ratio of science is urgent. According to data of the USSR Ministry of Instrument Making, Automation Equipment, and Control Systems, in 1980, 25 percent of the need of the national economy for instruments for scientific research was met, while in 1985, 20 percent of the need was met.

For overcoming the lag of the material, technical, and especially the instrument base of science a number of steps on the mobilization of this most important reserve of the intensification of research and development will be required. Among the organizational planning measures one should particularly note the special-purpose allocation of resources for the development of facilities of science and pilot experimental works. Such experience already exists in the planning practice of the current five-year plan in the form of the inclusion as a part of the state order of individual assignments on the construction and placement into operation of the capacities of facilities of interbranch scientific technical complexes. In the State Plan of Economic and Social Development for 1988 the construction of 71 facilities of interbranch scientific technical complexes was envisaged, for which more than 200 million rubles of capital investments were allocated, of them more than 90 million rubles with full backing by limits of contractual work were allocated for construction and installation work. Obviously, the further expansion of the scale of the special-purpose allocation of resources as a most important means of the planned management of the development of the material and technical base of science is required.

Moreover, the economic influence on the increase of the capital-labor ratio of scientific labor as a factor of the increase of the intensification of scientific and technical activity should be increased. Precisely for this reason the comprehensive evaluation of the conditions of the accomplishment of the introduction of a fee for fixed production capital in science is required.

The survey of a number of scientific organizations showed that during the preparation for work under the new economic conditions they, as a rule, made an inventory of the instruments, equipment, and test stands, which were on the balance sheet. As a result unnecessary fixed capital in the amount of about 5 million rubles, which comes to 4 percent of its total value, was identified and sold. The assets derived from the sale are being channeled into the fund of scientific, technical, and social development mainly for the financing of measures on the increase of the technical equipment of scientific labor.

At the same time the managers of organizations, which have expensive means of the automation of experiments and designing, powerful test stands, and advanced computing and data processing systems, are now already worried that the fee for them will make up a significant portion of the profit and will accordingly decrease the assets which are being channeled into incentive funds. Thus, the effect of this economic stimulus can come into conflict with the urgent need for the development of the material and technical base of science. The conflict in its content is close to the well-known problem of keeping pilot plants busy with the output of small batches and even the series production of new equipment, when the mechanical carrying over of the indicators of the evaluation of the efficiency of the activity of industrial enterprises to the sphere of research and development imposes on science the performance of the noncharacteristic functions of the duplication of innovations, weakening in so doing the pilot experimental development of scientific prototypes.

Obviously, a classification of means of labor, which takes into account the peculiarities of their use in science, should precede the introduction of a fee for fixed capital. On the basis of the classification when establishing the overall standard of the fee of the scientific organization it is important to proceed from the fact that for multipurpose fixed capital (computer hardware of general use, standardized measuring equipment and instruments, vehicles, and so on) it is possible adopt a standard at a level, which stimulates its more complete utilization, while it is possible to completely exempt from the fee means of labor, which perform special functions (unique testing equipment, stands, testing grounds, and others). Such an approach will make it possible, without infringing on the cost accounting interests of scientific research institutes that are actively developing their own material and technical base, to preserve the economic influence on the more complete use of means of labor.

As is known, full cost accounting and self-financing envisage the inclusion of the amortization deductions for the renovation of fixed capital in the expenditures on scientific and technical activity. A portion of such assets in conformity with the approved standard is transferred to the fund of scientific, technical, and social development. This step, on the one hand, increases the economic liability of the scientific organization for the end results of work and, on the other, broadens its possibilities in the pursuit of an independent investment policy which ensures the strengthening of the material and technical base.

At the same time the analysis of the work of scientific research institutes under the new conditions of management showed that when establishing the standards that regulate the distribution of the deductions for amortization, which are intended for the replacement of fixed capital, individual ministries preferred not to leave these assets at the organizations, but to channel them into the centralized funds for the development of production, science, and technology. In spite of the fact that the ministries plan to return a significant portion of the assets in the form of capital investments, the small share of the amortization deductions, which are left at the disposal of scientific organizations, are regarded by them as an infringement of cost accounting interests.

It is expedient to examine this problem in connection with the general concept of amortization policy as a means of economic influence on the acceleration of scientific and technical progress. The existing proposals on accelerated amortization envisage the shortening of the time of renovation, so that the basic outlays on the replacement of fixed capital would be taken into account in the expenditures on production during the first 2-3 years of the operation of means of labor. Under cost accounting conditions this means in practice the decrease of the portion of the profit, from which mandatory deductions are made (to the state and local budget, centralized funds, and reserves). Thus, the economic interest in the replacement of fixed capital and the writing off of obsolete equipment is increased.

Inasmuch as it is proposed to use accelerated amortization for the stimulation of the development of the priority directions of scientific and technical progress, as well as taking into account the need for the strengthening of the material and technical base of science and the formed trends of the worsening of its age structure, it is advisable to test this mechanism first of all in the sphere of scientific research and development.

In describing economic levers and stimuli as a factor of the intensification of the use of the scientific and technical potential, it should be noted that the sphere of their use at present is limited for the most part to sectorial and plant science. Meanwhile, more than 40 percent of the total number of scientists and science teachers are employed in the academic and VUZ [Higher Educational Institution] sectors of science. Therefore, the search for forms of the management of basic science, which are equal to the general concept of the restructuring of the system of the economic management of the economy on the terms of full cost accounting and self-financing, seems to be the most important direction of the increase of the efficiency of the use of the scientific and technical potential of the country.

Time Factor in Acceleration of S&T Progress

18140162b Moscow PLANOVOYE KHOZYAYSTVO in Russian No 1, Jan 89 pp 56-63

[Article by Doctor of Economic Sciences A. Seleznev under the rubric "Scientific and Technical Progress": "On the Consideration of the Time Factor in the Acceleration of Scientific and Technical Progress"]

[Text] Machine building is the key sector of scientific and technical progress, and the consideration of the time

factor in the development and use of equipment remains the basic problem of its development. The sources of acceleration are found precisely here. Therefore, in all the units of the machine building complex the organizational reserves have to be fully mobilized. The first steps in this direction have already been taken. But the main thing lies ahead. First of all the time of the scientific and technical preparation of production has to be shortened.

It is possible to accomplish this difficult task in a short time only on the condition of a knowledge of the laws of the intensification of production. It is necessary to comprehend fully the reasons of such a paradox, when the base of intensive development is reproduced extensively, while the base of extensively development is reproduced intensively. That is what happens, if intensification is carried out on the basis of the use of equipment and technology, which have undergo minor changes and do not make it possible to increase labor productivity significantly. When assets have already been invested in such equipment, one has to recover them, by expanding the field of production in time by the maximum utilization of such equipment and thereby stimulating the expansion of the production of the raw materials or materials, which are being consumed. The phenomenon of production for the sake of production emerges.

At present the measures on new equipment, the number of which in industry increased from 2,655,000 during the period of 1971-1975 to 3,476,000 during 1976-1980 and to 3,976,000 during 1981-1985, are in many respects of a formal nature. Every model of new equipment during 1981-1985 accounted for 229 measures on new equipment—1.7-fold more than during 1971-1975.

The tendency for the concentration in a new technical complex item of an increasing number of introduced inventions is being found. At first glance each measure on new equipment is becoming more and more science-intensive. However, this is far from the case—given the doubling of the number of inventions, which are embodied in the "average" unit of equipment, during the same period the progress toward the heights of world achievements in the development of equipment was not impressive. In 1986, 29 percent of the products of machine building corresponded to the world level, while in a number of sectors only 14-17 percent did. Fundamental changes also did not occur during 1987-1988. The decrease of the share of machines, equipment, and vehicles in the structure of Soviet exports and its increase in imports were an expression of the unessential changes in the production of new equipment. As a result the coefficient of the excess of the volume of imports of machines over exports increased from 1.52 during 1960-1970 to 2.61 in 1985, which in the history of our country during the postwar period had not existed. In 1985 the exports from the USSR of machines, equipment, and vehicles came to 9,855,000,000 rubles, while the imports came to 25,706,000,000 rubles. The share of machines, equipment, and vehicles in the structure of Soviet imports from 1980 to 1987 rose from 33.9 to 41.4 percent.

At the same time the tendency for the retention of a stably high share of inventions, which have not been introduced in the national economy, was found. During the 11th Five-Year Plan on the average 30.2 percent of the registered inventions were used a year. But even if it had been 100 percent, a qualitative leap in the level of equipment all the same would not have occurred, inasmuch as in the total number of inventions an overwhelming majority of them do not have a complete engineering solution, moreover, a large number of them are minor. The number of inventions can also increase further, without being accompanied by a significant increase of the level of equipment, if the time factor is not taken into account and the economic organizational mechanism of the selection of promising technical and technological solutions is not reformed.

It is necessary to reject the stereotype, according to which the introduction in production of only a third of the inventions is explained by the lack of receptivity of production to innovations, and to see more clearly the causes and consequences. It is also time to reject the prejudice that machine building has a large reserve of the increase of the stock of completed scientific and technical research. In order to achieve by 1990 a replacement of equipment of 13 percent (in 1987 it came to 9 percent, while in developed countries it came to 14-17 percent), the stocks of completed research have to be increased. But they, as practice shows, are decreasing rapidly—and once again due to the fact that among inventions there are not that many truly revolutionary ones. The search for original and highly efficient engineering solutions is being very poorly stimulated economically.

In case of the established practice of planning the production of machine building products, when the volume of the assignments for machine building enterprises exceeded their possibilities by two- to threefold, the producer enterprises gave preference to what it is easier and economically more advantageous to produce, to what is more profitable. But this is far from always equipment of new generations. Now the state of affairs is changing, inasmuch as the priorities are clearly specified. In all 44 priority directions have been formed. The Consolidated Program of the Implementation of the Priority Directions of the Development of Equipment of New Generations for the Thorough Modernization of National Economic Complexes During 1989-1995 will be implemented. A large number of assignments (140) on the development and delivery of fundamentally new types of equipment are being included in the state order when formulating the plan of the economic and social development of the country for 1989.

It seems necessary in the immediate future to formulate and implement a program of the improvement of sectorial scientific research institutes and design bureaus,

their technical reequipment, and the radical improvement of their management. The removal of sectorial scientific research institutes from the subordination of sectorial ministries and the halt of financing at the expense of the assets of enterprises, which are redistributed by ministries, their changeover to cost accounting and self-financing, as well as the effective use of the budget form of investment might be a condition of their efficient operation. The priority directions of scientific and technical progress cannot manage without budget "injections." But it is also possible to allocate budget assets in different ways—either for inflated estimates of the maintenance of all and everything or for the achieved result (or per unit of the planned result, but with the introduction of the institution of indebtedness to the state, if the result is not achieved). In such a situation sectorial scientific research institutes would cease to be a "servant" of ministries and to work for the meeting of the modest demands of user enterprises. But if self-financing were combined with the allocation of assets from the budget according to the principle of a reward for the achieved result, the informal restructuring of the work of scientific research institutes would be achieved more rapidly and dependence as one of the most dangerous zones in their activity would be overcome.

The need has arisen for the transformation of all sectorial and intersectorial scientific research organizations of primarily the applied type into powerful centers with developed engineering, which are capable of producing highly efficient science-intensive commodity production, which is suitable for the national economy, and of ensuring the increase of their contribution to the social product that is being created. For the present this contribution is very modest—at the beginning of the current five-year plan the amount of research and design work came to a little more than 2 percent of the volume of commodity production of machine building. About 40 percent of the scientific research institutes and design bureaus do not have a pilot experimental base.

The average capital-labor ratio of the personnel of scientific organizations, which in one way or another are connected with machine building, is also negligible—6,300 rubles, which is several fold less than in highly developed countries. By 1990 it has to be increased to 16,000 rubles per worker.

Large enterprises and associations, which do not have developed pilot experimental production, are dragging out the process of the "operational development" of new models of machines and equipment and their transfer to series production. In connection with planning "from the achieved level," which is associated with the achieved gross volumes and with an orientation toward these volumes, in a number of ministries the fulfillment of the basic planned load has been assigned to pilot experimental production, due to which it has gradually begun to lose the traits of pilot experimental production. And although planning "from the achieved level" in its volume-expenditure definiteness is being overcome, a new economic organizational basis, which is capable of creating the conditions of the shortening of the duration of the "research—production" cycle, is necessary for the development of pilot experimental production.

The advanced experience in the development of the cooperation of labor, which unites the named units, demonstrates the promise of scientific production associations, of which strong scientific collectives are becoming the nucleus. For example, as a result of the organizational merging of scientific subdivisions and production and the establishment of the Kriogenmash Scientific Production Association it was possible to shorten the above-named cycle to 2 years (and in the number of cases even less). The subordination of the activity of the institute and the production units to the solution of long-range problems brought domestic cryogenic machine building up to the leading levels in the world and made it possible to increase substantially the export of products and to meet more completely the needs of the national economy. An air distributor with a capacity of 70,000 cubic meters of gaseous oxygen an hour, which affords the possibility of obtaining from a square meter of area of a blast furnace 2- to 2.5-fold more metal than before, was developed. Each 1 million rubles of capital investments, which has been invested in the production of the unit, saves in a five-year plan tens of millions of rubles.

It was proven long ago that the path from the origination of a scientific idea to the development of new equipment, technology, and materials, as well as the time of large-scale introduction in production are much shorter depending on how the combination of the basic scientific result with its engineering and technological analysis is organized. If it is fundamental and is based on the union of theoretical and experimental research, the period of the introduction of innovations will be less protracted and their quality will be higher. Proceeding from the increasing role of the consideration of the time factor in the acceleration of scientific and technical progress, the Presidium of the Ukrainian SSR Academy of Sciences prepared a set of interesting steps on "technological orientation." For the increase of the readiness of scientific developments for extensive industrial introduction in the system of the Academy of Sciences its own experimental design and experimental production base is being established. By the beginning of the current five-year plan the total number of its facilities came to 74 as compared with 16 in 1965. Among them are 10 pilot plants, 27 pilot and experimental works, 32 design bureaus, and 5 computer centers. Scientific technical complexes (NTK's), which perform the entire cycle of work—from the idea to introduction—have been formed on the basis of large institutes. For example, in the Institut elektrosvarki imeni Ye.O. Patona Scientific Technical Complex there are six engineering centers (pressure welding, electron beam technology, the robotization of the production of welded components, electroslag technology, strengthening and protective coatings, explosion metal working), which in the shortest possible

time cope with the development of the most advanced welding equipment which does not have analogs in domestic and foreign practice. During the current five-year plan the introduction of this equipment will already make it possible to release up to 5,000 highly skilled welders and to increase labor productivity by three- to fivefold.

Temporary scientific production associations (VNPP's) and scientific technical cooperatives can become an effective organizational form that ensures the rapid development and introduction of new equipment. But they have not yet becoming widespread, mainly due to the lack of a system of the state hiring and rental of complex and scarce equipment, instruments, and other hardware and, in a number of cases, their leasing. Incidentally, such services can be developed on a cooperative basis. During 1987-1988, the Presidium of the USSR Academy of Sciences made a decision on the establishment of 43 temporary scientific technical laboratories. Some results of their work are also already available. Thus, the temporary laboratory of the Institute of High Temperatures of the USSR Academy of Sciences jointly with specialists of the USSR Ministry of Ferrous Metallurgy developed large power technology complexes for two plants; the temporary laboratory of the Institute of Metal Physics of the Ural Department of the USSR Academy of Sciences developed equipment for the checking of magnetic layers in the process of producing information media.

Along with the organizational aspect of the problem the economic aspect is of great importance. It is necessary to consider the fact that the changeover to new equipment, as a rule, for producer enterprises proves to be economically unprofitable. The scientific and technical preparation and production of its first specimens are expensive, the costs of the assimilation of the production of new types of machines and equipment prove to be much greater than in case of the production of old equipment. The large one-time investments have to be offset by means of their own revenues and the special fund of the development of science and technology, the difficult barriers, which are connected with the shortage of material resources, have to be surmounted.

The real advantage of the introduction of new equipment can be greater in case of the proper determination of its efficiency in production and in use. At any rate, the saving on the production of a unit of output of the total expenditures from the replacement of old equipment with new equipment is of fundamental importance for the user. And here the organized record keeping of the expenditures on production, especially on the assurance of the reproduction of the manpower that is being superseded by machines, and advanced methods of determining the efficiency of new equipment are necessary. Now when determining the cost accounting impact from the introduction of new equipment in the expenditures on the reproduction of the manpower being replaced at best the wage with the addition to it of not more than 14.2 percent is taken into account. But the public consumption funds, which serve the reproduction of manpower and make up about 41 percent of the average wage of workers and employees, are not taken into account. The correction factor to the wage, which is equal to 1.41, is not being used. But this, too, is still not everything. It is also necessary to take into account the fee of enterprises for manpower resources (for the formation of the corresponding funds for the assurance of the reproduction of manpower). It comes to 200-300 rubles a year, while respect to the average wage it comes to 8-12 percent. In connection with the extension of the principles of cost accounting to the economic interrelations within regions the payments for the reproduction of manpower can increase, and one must not forget this when settling the question of the efficiency of new equipment and its payback period. This feature should find reflection in the methods of determining the efficiency of new equipment, which will make more exacting the demands on the economic effectiveness of the expenditures on its development. Unfortunately, the question is not posed this way in the latest enforceable enactments.

The need arose long ago to announce competition for the development of a fundamentally new method of determining the economic effectiveness of new equipment and capital investments with its extensive discuss in scientific circles and to put an end to the extremely abstract approaches to the determination of its accounting efficiency. They also did not succeed in getting rid of such approaches in the modified, now prevailing method.

In addition to the above-cited considerations it is also necessary to take into account the duration and other conditions of the actual operation of machines and equipment with allowance made for the shift coefficient; the increase during this time of the average wage and other outlays on the assurance of the expanded reproduction of manpower. Thus, it is a question of determining the actual efficiency of technical innovations, which depends on practically all the factors that affect the use of equipment in time. The greater the capacity of the equipment being used is, the greater the losses are for society from its idle times. But they, unfortunately, are large and are due not only to the shortcomings of supply, but also to the fact that the complex interrelations and contradictions of highly specialized production are being inadequately taken into account in the management of the machine building complex.

It often turns out that the local results of interconnected cooperating enterprises are **different in quality** and incompatible. Thus, there are grounds to speak of the different quality of the results of machine tool building enterprises and enterprises of the electronics industry. Here the paradox of the formal integrity of interacting enterprises appears: the sum of the local results is not equal to the aggregate result in case of the different quality of the local results and their "disconnection" with respect to the operating characteristics.

The high quality, from a mechanical standpoint, of machine tools like the "machining center" is insufficient from the standpoint of its electronic support. For this reason such expensive equipment is often idle. Accordingly the output-capital ratio decreases and real acceleration is checked, but one must not allow this. The problem of the development within machine tool building of its own production for the electronic support of machine tools is now being worked on. But this is not a way out of the situation. The urgent need for the development of the machine building complex as an integrated intersectorial system, which unites all the units of the "research—production—marketing—operation" cycle, is being found. Then the isolations, which are inherent in departmentalism, will be eliminated.

The evaluation of the economic efficiency of new equipment in accordance with the criterion of its production capacity, which is calculated by the expert means, on the basis of its standard service life and the standard shift coefficient, seems advisable. In such a case the expenditures on the reproduction of the manpower, which is used in the process of operating the equipment, are also indirectly taken into account. For the higher the capacity of machines is, the fewer workers are required for their service. The criteria of the capacity of machines per unit of time along with other economic parameters (for example, the consumption of gasoline per 100 kilometers logged by motor vehicles in case of optimum loading and so forth) make it possible to approach in a more sound manner the choice of technical solutions from the standpoint of their conformity to the best world analogs. Here, in order to avoid overstated estimates of the rated capacity of equipment, it is expedient to use the indicator of labor productivity, which is calculated in accordance with the labor intensiveness of the production of items by means of the new equipment in standard hours.

The consideration of the time factor should also be carried out with respect to the criterion of the reliability of equipment and machines and operation and with respect to the assurance of the most comfortable working conditions, under which the maximum "yield" of the labor potential of the personnel, who are engaged in its attendance, is possible. As an additional criterion of the assignment of equipment to a new generation it would be advisable to consider the ability of the equipment being used to ensure the reproduction of ecologically safe production conditions.

If in technical development the forecasting of changes in world development and the speeding up of scientific and technical preparation become the basic reference points, the real possibility of a "breakthrough" and the assurance of the leading position and competitive ability of equipment is created. Exploratory work is being launched in precisely this direction at several machine building enterprises. In particular, relying on forecasts, designers of the Minsk Motor Vehicle Works are working on a model of a motor vehicle of 2000, which is based on a fundamentally new configuration—a new generation of articulated trucks of the modular type is being developed.

In the development of equipment it is impossible to achieve substantial changes, while leaving as before the mechanism of the resolution of the contradiction between the acceleration of scientific and technical progress and the lengthening of the time for innovations to get through evaluation and for their value to be officially recognized. This depends to a decisive degree on the organization of expert evaluations of innovations, especially scientific discoveries and inventions. Such an evaluation is given mainly by departments, and not scientists. Unfortunately, in our country proper attention is not being devoted to scientific evaluation.

The establishment on the basis of cost accounting of centers of not only scientific, but also engineering evaluation and a system of the evaluation of the preparation of the production of new equipment is expedient. It is necessary to take prompt steps so that the very process of its development would not be dragged out due to the low technical equipment of the labor of developers, as well as due to the excessively complicated procedures of consultations (until recently they were regulated by All-Union State Standard 15.001-73). But, after all, the specification of the parameters of the item in the technical assignment or in the order of the consumer is sufficient. This is becoming a serious economic problem—for the more bureaucratic instances there are, the more expensive their maintenance is and, consequently, the higher the expenditures on the development of equipment are. Such lengthy procedures on the coordination of the placement of new items into production as in our country do not exist anywhere in the world.

In 1984, a very significant and promising step was taken in the necessary direction. The State Committee for Science and Technology approved the Statute on the General Designer for Basic Types of Machines, Equipment, and Instruments, Which Are of Great National Economic Importance. In conformity with the Statute the general designer is given powers that actually make it possible to take fully into account the effect of the time factor. And the point of this document reduces to lifting from the managers of design collectives various restrictions in the procedures of consultations and the making of the entire set of decisions, by which the materialization of innovative ideas are accompanied in one way or another. However, in the enormous machine building complex there are today altogether few general designers and they are not willing everywhere to recognize their extraordinary powers.

It is possible to organize in our country a system of the evaluation of the level of new equipment by analogy with the system operating in the GDR. At its basis is the unconditional halt of the production of unpromising and inefficient equipment in combination with the guarantee of a significant incentive for the developers of new

equipment subject to its efficient, moreover, by means of assets that are allocated in a centralized manner. The planning of the production of new equipment is based on standard parametric principles and the consideration of the time factor. The achievements of the GDR in this area are well known and have received international recognition.

Taking into account the inertia in the use of even not very promising equipment, here they establish exacting demands, which are recorded in "notebooks of obligations" and which the models of new equipment, which are being developed at combines and are recommended for series production, should satisfy. Thus, at the Umformtechnik Combine (Erfurt) the following technical and economic parameters, below which the characteristics of the equipment being put into production cannot be, have been established: the increase of the consumer properties by more than 25-30 percent, the decrease of the specific expenditures of materials as compared with the old item or the average indicator—by 15-50 percent, the decrease of the expenditures of working time on the production of the new item as compared with the old item or average level for this group of items—by 20-25 percent, and the increase of the profitability of the combine with respect to exports—by 10 percent.

The rapid development of fundamentally new equipment requires large capital investments, including associated capital investments, and a scientifically substantiated ratio of the expenditures of labor at the different stages of the scientific and technical preparation of production and in case of the direct manufacture of products. This is one of the most difficult problems, inasmuch as it is connected with the structure of personnel—with respect to training and business skills. Advanced experience shows that in the preparation of production (including the development of specialized equipment) it is advisable to use up to 25 percent of the personnel, while in machine building it is advisable to use even more. For example, at the Ternopol Vatra Production Association (the supplier of high quality lighting equipment) as a result of the optimization of the indicated ratio the time of the preparation of the production of a new product was reduced during the 11th Five-Year Plan to two-fifths to one-half. Here they produce nearly all the equipment for themselves. Of course, there is no need to strive for this everywhere and thereby to bring business to a certain self-sufficiency. It is a question of the development of modern production in the organizational form of interbranch complexes, which unite developed engineering services and modern technical and technological support, especially if production is unique.

It is difficult to release resources for capital investments, but it is possible not to "tie down" considerable assets with obviously unpromising investments, avoiding structural "overaccumulation" and the creation of unnecessary workplaces. It is impossible to perceive in a noncreative manner the thesis of K. Marx that "low labor productivity is identical with small amounts of fixed capital with respect to that portion which is spent on wages."[1] In economic practice it was assumed that it is sufficient to ensure the faster growth of fixed production capital with respect to the increase of the number of personnel employed in the process of its use, and high labor productivity and production efficiency will be ensured. A "body check" of this sort is very expensive and leads to the decrease of the efficiency of production accumulation. The shortcomings of the method of the determination and the standard regulation of the effectiveness of capital investments are contributing to this.

It is necessary to establish for national economic complexes—the agroindustrial, machine building, and fuel and power complexes—scientific substantiated standards of efficiency, which, moreover, are sufficiently strict, intense, and at the same time realistic and reflect the requirements of the critical moment in the development of the processes of the intensification of reproduction. At any rate, the practice of the spontaneous formation of standards of the effectiveness of capital investments is not completely consistent with the requirements of the consideration of the time factor, inasmuch as here the payback period of the expenditures is also determined arbitrarily. The investment process is oriented toward the comparatively slow recovery of capital investments, toward a high proportion of unfinished construction in their amount, and toward ineffective investment decisions, including decisions with respect to the level of the equipment being used. As we see, everything is interconnected and it is necessary to settle these questions together.

In the stimulation of the production of high quality equipment it is also necessary to take the time factor into account as much as possible. Here the expansion of the practice of using contract prices is of decisive importance. They, in essence, are aimed at protecting the consumer against the necessity to extra payments to the manufacturing enterprise in instances, when the price is fixed, while the quality is "floating." On the other hand, contract prices guarantee the derivation by the manufacturing enterprise of an additional profit, if it strives for the parameters that are stipulated in the order of the state or the user enterprise.

However mature the organizational form of the development and assimilation of new equipment is, the problem of competition in the process of its devising, moreover, in terms of the development of systems and complexes of machines, which support the entire cycle of technological solutions with the use of the latest achievements in the area of design, ergonomics, and ecology, remains most urgent. As was already stated above, assets from the state budget could be allocated on a competitive basis.

Some experience already exists in the organization of competitions. In particular, a new car for the metro, which was recognized as satisfying the long-range

requirements, was developed on a competitive basis. In 1977 competitions for the development of fodder harvester combines and for passenger elevator cars and cabs of tower cranes were announced. The holding of such competitions will become the norm of creative scientific and technical work only on the condition of the more thorough analysis of the economic problems of their organization. In the model statute on the holding of competitions for the development and designing of products of machine building, which was approved by the USSR State Committee for Science and Technology on 23 July 1978, it is stipulated that they are held at the corresponding levels. Ministries announce competitions for the development and designing of complex and unique items of machine building. Enterprises (associations) and organizations directly organize competitions for the development and designing of items of machine building with respect to the products list attached to them, interbranch scientific technical complexes do so with respect to the directions of scientific and technical progress, which are attached to them, and the State Committee for Science and Technology organizes competitions for the development of items, which are of intersectorial importance, and with respect to the themes of the Comprehensive Program of Scientific and Technical Progress of the CEMA Member Countries to 2000. The period of the submitting of designs and timely notification of the holding of competitions are envisaged by the statute. But the prizes are established "by ranks," and not directly subject to the efficiency of the developments. The winners of the competitions, which have been announced by enterprises, can count on a prize in the amount of up to 5,000 rubles, while the winners of the competitions, which have been announced by ministries, departments, interbranch scientific technical complexes, and the State Committee for Science and Technology, can count on a prize of respectively 25,000, 30,000, and 40,000 rubles. Thus, the amount of the prize is also becoming an indicator of the contribution to the solution of the problems of scientific and technical progress. For some reason it is assumed that the competition announced by an enterprise should obviously yield less impressive results than they can, if the competition is announced by departments. Such a philosophy is vulnerable.

Thus, individual aspects of the consideration of the time factor in the development of new equipment have been examined. In expressing our opinion on this question, we invite the broad group of specialists to discuss the problem.

Footnote

1. K. Marx and F. Engels, "Soch." [Works], Vol 26, Part II, p 4.

Reprogramming Resources To Overcome Technology Lag

18140129a Moscow NTR: PROBLEMY I RESHENIYA in Russian No 21, 8-21 Nov 88 p 4

[Article by A. Lepikhov, under the "Opinions, Evaluations, Trends" rubric: "Objectivity of Analysis." Passages in boldface as published]

[Text] **Science and research activities are connected by thousands and thousands of continuous threads to the flow of "fast-paced life," to society's entire life, and to its afflictions.**

Yet, as A. Aganbegyan, academician-secretary of the Department of Economics, said at the USSR Academy of Sciences General Meeting, these afflictions are obvious even to the naked eye. In actual fact, the plan for the current 5-year period is not being fulfilled in terms of many indicators, and for the time being most Soviet people do not feel the material fruits of restructuring and, moreover, some families think that living has become more difficult.

Above all, this is because the "economic hole" that we are climbing out of turned out to be much deeper, and its walls—much steeper—than could possibly have been imagined. That is why even the measures taken to overcome the forces of inertia have not been as basic and radical, as seems necessary today. Besides the half-heartedness of many of the decisions being made, one can also not help but see the mistakes that we have made and are making in converting to the new economic management system.

In short, today we are undergoing, as was stated repeatedly at the 19th Party Conference, a determining time, a critical, turning-point stage of our development.

With what "baggage" did our science arrive at this stage? Above all, this can be judged by the data from a survey of some 400 academy members, on the results of which USSR Academy of Sciences President G. Marchuk spoke. Here it is: we hold a leading position or are at the world standard in approximately 40 percent of the high priority areas of world science (basically theoretical). We are lagging in the remaining 60 percent of research areas. It is estimated that we could eliminate about "half of the lag" in 5-10 years. As far as the "other half" is concerned, the lag is such that enormous efforts, both by scientists and by the state, are needed in order to overcome it. A few examples, to illustrate: our lag in basic research on the componentry of computers, supercomputers, mass-use computers, computer networks and software is growing especially greatly and steadily. The situation with personal computers is even more alarming. The four models of such computers, developed by our industry, are incompatible among themselves, few are being produced, and somehow they simply are not reaching the academy scientists.

A lag is also observed in high priority fields, such as high speed aerodynamics, turbulence theory, and the computerized modeling of dynamic systems. Today, we have lost our leading positions won earlier in the theories of elasticity, of plasticity, of membranes, and of vibrations.

On the whole, our country lags significantly behind the developed capitalist states in terms of the production volume, assortment and quality of new materials—polymers, ceramics, and metallic and composite materials. After all, in the opinion of specialists, right now the world is entering the age of composite materials—light, sturdy and technological—which will replace 50-75 percent of steel and cast iron in the near future.

What are causes of the situation which has been created? The first is an acute shortage of modern scientific instruments, computer hardware, reagents, and special equipment. Another is the serious situation with providing laboratory and production facilities for academy scientists. Yet another is the backwardness of informational support for scientific research (the insignificant number of foreign journals subscribed to, the lack of computerized means for communications and tele-access to data banks, and intolerable gaps between the needs of basic science and the capabilities of the academy's publishing and polygraphic base).

However, so to speak, there is nothing new under the sun. These and other "plagues" of our academic science have been stated many times at USSR Academy of Sciences General Meetings and have been written about in the press.

Fortunately, the current General Meeting did not merely limit itself to verifying the situation which has formed and to the traditional appeals "to improve work," but proposed a large-scale program of specific actions for Soviet scientists.

Above all, the scientists think it is necessary to pass a document at the state level which would establish the priority of basic science over the material production sphere, from the viewpoint of distributing all resources, as well as to begin work on a draft USSR Law on Science, which would define principles for its development and interaction with economic sectors (including higher schools).

It was also deemed necessary to increase the current outlays for science by a factor of 4-5 (right now the academy's budget is about 2 billion rubles), and the amount of capital investments and subcontracting work—by a factor of 2-3, until 1995.

Incidentally, the first step in this direction has been taken. Next year the academy's budget will increase by 500 million rubles. Let us note that in the "stagnant" times, scientists received this kind of financing increase in the course of a decade.

Most likely, the main thing is that, beginning in 1989, academic (and also VUZ [Higher Education Institution]) science is converting to the new planning system. Now, specific scientific programs and research projects will be financed, not institutes. Here are some of the details of this new system. Firstly, all academic scientific research institutes will receive, from the departments, 30 percent of the total volume of their budget allocations for the present year, at their disposal for conducting exploratory research. Here, the guiding role of the USSR Academy of Sciences Presidium ends. Whom within the institute to give the money to, what sort of research to spend it on, which researchers to give a "green light" to, and which to stop—these most important problems will all be solved only by the institute's scientific council, based on the competitive selection of projects presented by the researchers. Without a doubt, however, it will also bear full responsibility "for the success of the enterprise."

Secondly, certain funds from the budget will be allocated for fulfilling the specific assignments and resolutions made by directive agencies. In other words, an institute will receive money, if it does that which the state needs at a given moment or in the near future.

Thirdly, state scientific and technical programs will be drafted and fulfilled according to the line of the USSR GKNT [State Committee for Science and Technology], beginning next year. Sectorial, academic and VUZ organizations can undertake their implementation, on a competitive basis, naturally. Work on state programs will be financed by ministries and departments using their own funds. Thus, any academic institute can become much wealthier, if it succeeds in competing for the fulfillment of one state program or another.

However, like everything, competitiveness also has a reverse side. It can be expressed briefly: "Who are the judges?" In other words, who will evaluate the recommended scientific projects, who will make an impartial and strictly objective conclusion regarding the value of the ideas of one researcher or another?

There is another problem. The history of science shows that sometimes even the most skilled experts have failed to understand and, with a clean conscience, unanimously rejected ideas which, years later, became the main directions of research work. Unfortunately, as Academician V.I. Vernadskiy noted, those who bear the scientific outlook for the future are always in the minority. In short, the approach to planning research work that was set forth at the General Meeting also entails some unresolved problems for the time being. However, we must see the main point behind these problems, which is precisely the fact that the new system of financing, which "takes effect" as of 1 January 1989, will make it possible to take the first steps toward the truly profound integration of academic, VUZ and sectorial science, and to decisively improve the process of research management.

Cheap Labor Viewed as Obstacle to Introduction of New Technology

18200221 [Editorial Report] Moscow PRAVDA in Russian on 23 February 1989 (first edition) carries on page 2 a 1400-word article entitled "Children's Home for... Parents, or What Is Impeding the Introduction Into Production of Scientific and Technical Achievements." The article is signed by V. Yaroshenko, deputy managing director of the Scientific-Production Association of the State Union Tractor Scientific Research Institute, Moscow.

In the article, Yaroshenko supports the right to "intellectual property," that is, the right to patent new discoveries and inventions and the additional right of both the inventor and the sponsoring ministry or department to sell scientific information to other organizations.

In addition, Yaroshenko states that the low cost of labor in the USSR acts as a disincentive for factory managers to incorporate new technology into their production processes. He cites the following example: "If, for example, a welding robot costs $150,000 and replaces two U.S. workers with an annual wage of $15,000, then it will pay for itself in only 5 years. If we try to install the same robot in one of our plants, then it will pay for itself only after 15 years, since the wages of our workers are about 5 times less than those of an American worker." He suggests increasing the workload and then reviewing the issue of "a significant wage increase." Yaroshenko claims that it is possible to increase wages without increasing inflation by the gradual "liquidation" of loss-making enterprises, a process which can be accomplished by introducing leasing or cooperative arrangements. He concludes that these measures "will not only create greater interest in the introduction of the latest scientific and technical achievements, but will also allow us at last to be free of the imaginary labor shortage. With a high level of labor productivity and high wages, all enterprises and organizations operating under conditions of full economic accountability will quickly get rid of unnecessary, expensive work positions and personnel."

S&T Coauthorship Policies Attacked

18140158a Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 15 Jan 89 p 2

[Article by Professor V. Yatskov, doctor of economic sciences: "'Eureka'... In Chorus. Moral and Economic Costs of Coauthorship." Passages in boldface as published]

[Text] **Our society is reasonably disturbed by the fact that recently in a number of directions, Soviet science has started losing pace and lagging behind the world level. It was no accident that the 19th Party Conference had to raise the question of creating a qualitatively new scientific potential. Why did this happen? It seems, significant damage was inflicted on our science by underestimating the role of the individual, of the scientist's personality and talent. The violation of moral norms was a consequence of this.**

I have always wondered: why, with rare exception, do poets, writers, artists, and representatives of a number of other creative professions have no coauthors? When I asked an Academician friend about this, he answered without a shadow of doubt:

"In art and literature you need talent, a calling, a natural gift. In short, a person's individual capabilities. Of course, without talent nothing new would happen in science either. However, for some reason it is thought that the scientist's labor is collective to a great extent..."

I cannot agree with this viewpoint.

In my opinion, the question of coauthorship in science is one of the main questions in interrelations among scientists. To this day, they prefer to stay silent about it in nominations for prizes and awards and when preparing scientific works and articles for press. Meanwhile, it is precisely coauthorship which has made it possible for a large army of people, lacking the a scientist's true qualities, to accomplish "breakthroughs" in science. However, to make up scientific qualities, they do possess a rather large amount of power.

Many employees at various levels of management have used coauthorship to obtain scientific degrees and titles. Mediocre people, and even people with under-average capabilities, began to penetrate science. The true scientists were diluted in this mass, and the features of scientific schools were eroded. It was not simply a "littering" of science that occurred, but also a saturation with such cadres, which, having taken power into their own hands, began to direct its development in far from the best manner. This has had a much stronger effect, than shortages of material resources, equipment and instruments.

Scientific "production" possesses the specific feature that both the quantity of researchers, their supply with equipment, and the organization of work often play a secondary role. The qualitative indicators of the cadres—their capabilities, knowledge, competence and practical skills—are of primary importance. First-rate equipment only strengthens the action of the intellect—the basic tool of scientific labor.

Scientific ideas—hypotheses, concepts, theories and principles—materialize in reports, articles, monographs, inventions and experimental models. Novelty and originality should be an indispensable property of such production. However, discoveries are the main product of science.

Here, unfortunately, often it is not the quality, but the quantity of publications that serves as an indicator for evaluating a scientist's labor. Yet everyone understands that no two publications are alike. A large monograph or report, containing new results and the fruits of the author's many years of research and thought is one thing. Can an expanded thesis with a dozen coauthors, which has no scientific or practical significance whatsoever,

really be compared to these? Today, according to existing evaluation criteria, their weight in a scientist's overall baggage is identical.

Because of this, a real "pursuit" of quantity in printed works is occurring. Some scientists who possess power—scientific research institute directors, chiefs of departments or laboratories—have a quantity of publications which does not lend itself to reasonable explanation: dozens of works a year! After all, a person would be physically incapable even of simply rewriting that many pages! How can these be called ideas! Poor Albert Einstein, with his not quite 3 score publications, or Lenin Prize winner V. Novozhilov, with his ten works. Can they really compete with the authors of 300-500 scientific works?! The era of stagnation was a period for the flourishing and tempestuous growth in the prestige of this sort of scientist.

It was almost impossible for some young scientist or junior scientific associate to penetrate their dense system onto the journal pages. True, if the idea had merit, they benevolently took him into their company. However, at the last minute it would happen that the name of the discoverer disappeared from the list of authors. Yet, everything was considered normal. An entire system operated to shut out "outsiders"—mandatory preliminary discussions, reviews, acts of expert analysis, and accompanying letters. Without these, not a single article, not even the theses of speeches at some sort of conference or scientific seminar would be able to get through the numerous barriers.

In order to justify all forms of coauthorship, including forcible, the opinion was instilled in every possible way that everything in modern science is solved by a collective, not by one person. The theory that many joint problems require the efforts of different specialists was very convenient for those who themselves do not haul their share. Since there are many of these, "collectivism" in its worst interpretation became a cult. Scientific administrators, holding the posts of institute director or subdivision leader, began to consider almost all results obtained in their collectives as "their own." Their signatures on works by subordinates became standard. It is even good, if the individual is still in the coauthorship.

The moral costs of this practice are tremendous. It has given rise to a firm conviction among many scientists that it is better to add a higher chief to the coauthorship, to support that which they want from you, and write an article for someone, than be reputed as obstinate. They simply will not let you work normally! Thus it has turned out that qualities like openness, honesty, and truthfulness have been consistently trampled out of science's spiritual life. So, the path of careerism was set down. Knowing how to contrive, to say yes, and to oblige began to be valued.

In his work, "*Yeshche Odno Unichtozheniye Sotsializma*" [Yet Another of Socialism's Abolishments]" published back in 1914, Vladimir Ilich Lenin writes: "In old pre-revolutionary Russia the division of scientists into two large camps prevailed: those who adapt themselves to the ministry, and those who are independent, and the first were directly understood to be scribblers for hire and compilers of compositions to order."

It is bitter, but even now a scientist's worth is often determined by his position and title, not by his scientific contributions. A fusing of scientists to the bureaucratic chair occurred, and began to affect the selection of the directions and subject matter for research. Often, preference was given not to the most promising and topical works, but to those which satisfy personal mercantile interest, those offering hopes of new rank.

The individual's role in science is exceptionally great. It is also indisputable that in order to materialize its ideas, to achieve the final result, enormous intellectual and material resources, as well as collective forms of labor organization, are required. There are no contradictions in this. It is simply that authorship, the author's right, should be reserved for the idea's true author, without depending on his rank.

People cannot think and act identically, even if they are joined by common goals and interests. Twenty people cannot shout "Eureka" simultaneously!

Let us be frank: not only in science, but also in industry, in various ministries and departments, and in nomination for various types of prizes, it is possible to discover many who love to seize another's glory. Appeals for leading comrades not to "sign themselves on" as coauthors of articles and inventions, which they have no relation to, continue to fill the air. However, the situation is not changing.

In Academician B. Paton's opinion, in order to struggle against mediocrity in science, for starters we should try to evaluate the scientific baggage not by the overall number of scientific works (which should be excluded in general), but by their quality and use by others. The number of patents given and accepted, of author's certificates received for inventions, and of invitations to speak at scientific conferences, seminars, councils, meetings, and various scientific societies, should also be taken into account. After all, everyone knows that the more interesting the scientist, the more original his idea, the more invitations he will receive, and the more references to his works there will be in the professional literature. In short, we need only desire to change the evaluation in principle, and criteria will be found.

The knot of problems surrounding coauthorship and pseudo-scientists is complex, but solvable. The more demanding we are of each other, the more rapidly we will clean up the sticks, rubble, and stones that have spoiled the scientific landscape so tangibly and for so long.

New Working Group Studies Paranormal Phenomena

18410155 Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 22 Jan 89 p 4

[Interview with Firyaz Khantseverov by M. Dmitruk, date and time not given, under the rubric "Encounter with an Interesting Person": "I'm Convinced, It's Time to Rehabilitate ESP." First paragraph is SOTSIALISTICHESKAYA INDUSTRIYA introduction]

[Text]The administration of the Union of Scientific and Engineering Societies of the USSR has created a committee on the problems of transferring information by energy in nature. Its tasks are to comprehensively study phenomena whose existence is denied by many of our scientists: thought transmission over long distances, treatment with biofields, acting on objects without touching them, etc. Do we need to waste our strength on what authoritative specialists consider pseudoscience? This is how our correspond began his conversation with the committee's cochairman, F. Khantseverov, doctor of technical sciences.

F.Khantseverov: To start with, let me say that this field isn't classified as a pseudoscience everywhere. Research on parapsycholog—the science of the untapped capabilities of the human psyche—is widespread abroad. About 250 laboratories, colleges, institutes, and universities in more than 30 countries are participating in the work. Dozens of specialized journals are printed; thousands of scientific works are published; dozens of dissertations on para-phenomena are defended. At higher educational institutions, student acquire the knowledge and skills required to search out, identify, and study people with extrasensory gifts.

To be just, one must say that it wasn't easy to establish parapsychology there either. But now the stage of rejection has past, and it is officially recognized as a fundamentally new field. For example, this happened 19 years ago in the USA, when the parapsychology society became a member of the American Association for the Advancement of Science. Now parapsychologists work on equal footing with representatives of academic groups at its congresses. More than 130 organizations in the USA are engaged in researching parapsychology phenomena. They include major universities such as Washington, Chicago, Columbia, and Duke. Researchers are not concerned with debates about the reality of phenomena, but about problems of their practical use. Unfortunately, not only for peaceful purposes. Experts from US military-industrial companies concluded more than 10 years ago that paranormal phenomena, which are based on little studied laws of naturepreflecting the deep-seated properties of living and nonliving matter, can be used very extensively, including to create fundamentally new types of weapons.

Practical actions naturally followed these conclusions. For example Mankind Research Unlimited Corporation has collected considerable resources to comprehensively solve research and applications problems. It performs expert evaluations of psychotronic war methods and develops devices to monitor and control people. The company is trying to use telekinesis to turn electronic devices on and off remotely and is seeking ways to affect the brain to make it possible to erase information in the memory and introduce new information. Company specialists are selecting candidates and training parapsychologists who can detect a disguised weapon, snipers, mines, and traps and train scouts and diplomats.

The National Security Agency, the CIA, FBI, the Defense Department, and NASA buy and use this research. As you see, the organizations are well-known and solid. They would hardly waste money on studying non-existent phenomena, on charlatanism.

But then, judging by your story, there is a real danger that an imposing area of knowledge can be militarized?

Khantseverov: Any scientific achievement can be turned to evil. All the more reason why we cannot ignore this field.

SOTSIALISTICHESKAYA INDUSTRIYA: In our country, parapsychology has come to be called bioenergetics, but this hasn't changed the academics' attitude toward it. For example, just recently on the TV show "Ochevidnoye—Neveroyatnoye", corresponding member of the USSR Academy of Sciences M. Volkenshteyn and doctor of physical mathematical sciences S. Kapitsa said that scientists will not study bioenergetics, and that telepathy is for illusionists.

F. Khantseverov: What's more, what's the value of the statement that an interest in the wonders of bioenergetics is typical of a society's period of decline, its decay and stagnation. This sounds harsh, and after such statements few would decide to get involved, not to mention to promote such a compromising field. But in my opinion, these conclusions have little in common with scientific discussion. Attaching labels instead of open and serious polemics has never benefited science. There are well-known examples.

By the way, it is precisely during the period of stagnation that bioenergetics didn't blossom, but just the opposite, completely withered. That's no surprise. The dictates of science threatened adherents with excommunication from research if it were to become known that they were engaged in mysticism and other deviltry attributed to bioenergetics. Research was done in free time, almost underground. And when defenders of the purity of science learned about them, they called the adherents charlatans, denounced them, and didn't give them a chance to respond to criticism. N. Sochevanov, A. Okhratin, A. Chernetskiy, B. Iskakov, A. Medelyanovskiy, and many others were attacked.

I'm bold enough to assert that the position of real scientists should be different, the unknown must be studied in order to understand its realpnature. The well-known principle "this cannot be because it can never be" has no place in scientific analysis.

SOTSIALISTICHESKAYA INDUSTRIYA: I agree that there is no point in dividing the truths that natural scientists have achieved into the permitted and not permitted. But there remains one doubt. In order to study the psyche's untapped capabilities, one must deal with psychics, and most of them, judging from press reports, are either swindlers or people psychically disturbed. And there are also the simple speculators, grafters, and crooks. It's not difficult to compromise bioenergetics with this crowd.

F. Khantseverov: Of course, there are shady characters among those who are highly sensitive, just as in any area of human endeavor. But why single out bioenergetics? I'm not about to reproach journalists for tendentiousness, I only want to offer food for thought. The USA and several other countries consider ESP a national property. England, West Germany, France, China, Korea, and Viet Nam have data banks which store data on people with potential ESP abilities. They are officially and purposefully used to solve scientific and applied problems. Those countries have set up professional training of people who have ESP and grant diplomas, including medical diplomas.

For example, in England more than 20,000 people with ESP officially participate in a treatment program, and a million patients use their services every year. In the USA 6,000 trained ESP practitioners work finding oil, gas, water, and damage to underground utilities by biolocation. Overall, several countries have long had national programs to search out, test, and carefully select people gifted in ESP.

I'm convinced that it's time for us too to rehabilitate ESP, to arrange to train anyone willing in methods which develop the psyche's subtle capabilities, which everyone has in a dormant state.

SOTSIALISTICHESKAYA INDUSTRIYA: I remember the famous advice of physiologist Claude Bernard. "When one encounters a fact which contradicts the prevailing theory, one must accept the fact and reject the theory." But you'll agree that one can also understand your opponents. It's not so easy to change established ideas, to renounce preconceived ideas.

F. Khantseverov: Indeed, bioenergetics phenomena are distinguished by surprising features which also give the impression that it doesn't fit in with modern scientific ideas. But this impression is superficial. Deeper analysis shows that it's only with established classical ideas that bioenergetics doesn't fit; it doesn't contradict the latest advances in scientific thought at all. For example, its phenomena are confirmed in several areas of non-classical physics: quantum theory, the new concept of time, the theory of self-organization, etc. By the way, in the West representatives of "official," including basic science, Nobel Prize winners W. Pauley, B. Josephson, D. Eckles, and others participated in the development of parapsychological theory. More than 30 theory, concepts, and models have already been created, and each makes it possible to substantiate some portion of paranormal phenomena. Some of them can be classified as idealistic. But our task is ultimately to find rational elements in these concepts, and to interpret them from the standpoint of materialism.

SOTSIALISTICHESKAYA INDUSTRIYA: What practical results can we expect from the development of bioenergetics?

F. Khantseverov: A valid question. When Gregory Mendelelyev was experimenting with peas, would he have suggested that he was laying the foundation of future genetics, which in turn provided the broadest opportunities for the development of biotechnology? Did Ernest Rutherford suspect what would be the practical consequences of seemingly purely scientific experiments on artificial transformation of the elements? We have already talked about some results of bioenergetics research, and in general there are quite a few applications.

Developments in transferring information in energy form could be used in industry, transportation, geology, communications, electronics, agriculture, medicine. But this requires that research be broadened. Let's study what we don't understand, let's debate and refute. Only we don't need to drive an entire field of research activity underground.

Results of Poll on Restructuring in Science

18140129b Moscow NTR: PROBLEMY I RESHENIYA in Russian 20-31 Dec 88 p 6

[Article by L. Averyanov, candidate of philosophical sciences, and V. Baronin: "Will Cost-Accounting Destroy Science? Results of Reader Survey"]

[Text] No matter what standard we apply to the life of modern science—sectorial and academic—it is hard to rid ourselves of the thought that its "temperature" has been entirely normal in recent decades. True, there were crises. Individual fields had been declared anti-Marxist and their supporters and bearers made anathema. However, the predominant background was that of a unique scientific nirvana, within whose framework at a small, average, or sometimes even a fairly high-level scientific research institute,-design bureau-headquarters, time could be well spent with a circle of highly educated and even simply pleasant people. Then along comes restructuring and cost-accounting.

The scientists became confused. "Restructuring," they declared, "is a problem, but it depends on the leaders. It is disadvantageous for most of them (67 percent), and therefore this bunch of captains of science (67 percent) are jabbering about it to use up time and are doing nothing." This is a fragment from the analysis of a survey on restructuring in science, which the NTR editors held this spring (see NTR No 6 and No 12).

This reaction could have been predicted more or less accurately. The time was too long, in which carrying out instructions, knowing how not to argue, and not showing oneself were considered the chief virtues. It was precisely those who had an opinion of their own and "spoke out" with it, opposing the precious, "historic" instructions, who were ostracized.

However, time moves on. Under the new economic management system, material production has been forced to reject the results of scientific research and development work, if it has nothing more valuable to offer than reports. Thus, science should really be a material force, and should convert to self-support and cost-accounting.

What was the attitude of NTR readers to this? The NTR editors turned to scientists, production workers and students, as well as administrative employees, with a package of questions on cost-accounting, after publishing a regular survey in No 19 of the bulletin.

Two months passed. We received answers from the most remote corners of our country. Although the editors are still receiving surveys and fairly verbose letters, articles and suggestions, they have decided to acquaint the readers with some of the survey results.

We would like to begin with the following: it seems to us, there are few naive people who would have calculated that the first steps of restructuring could be successfully taken without the state's support, as they say, on bare enthusiasm. State support does exist. There are laws on converting all scientific subdivisions to cost-accounting, as well as on enterprises (associations). Hence, the questions of whether the law on the enterprise can serve as a powerful factor in raising the efficiency of science, and how it will be put into practice (the first and 14th questions in the survey).

Fifty-four percent of those surveyed believe "yes, it can." With regard to skeptics ("it cannot"), there were relatively few—only 20 percent.

The answer to the following question forces one to think. Not one of the several hundred readers who responded to the questionnaire, said that this law is being fully implemented, while 62 percent said "No, it is not being fully implemented," 26 percent said "it is not being implemented at all," and 12 percent declined to answer.

Does it really turn out that the law could be a stimulus, but it is not, since it is not being implemented? A paradox? Hardly. In first place, it is far easier to create a law, even a very good one, than the socioeconomic conditions for its functioning and application. Obviously, this work has still not been done. On the other hand, there are forces which do not need these conditions and this law.

Really, what good can a new law and cost-accounting in science do for someone who has nothing but a dissertation and obedience. With such baggage, a different problem is settled: sit through these innovations quietly and peacefully until retirement. It is no accident that some readers sent letters about the destructiveness of cost-accounting for science. They see it as an apocalypse.

It would seem, let them pass! However, refuting someone else's opinion is not the same thing as establishing one's own. Indeed, fears for the fate of science under the conditions of cost-accounting are not without grounds, particularly at the immature stage in the commodity-monetary relations between it and industry. Besides which, our science itself has been structured rather rigidly: there are academic, sectorial, VUZ [Higher Educational Institution] and factory sciences. Without being distracted by a debate on whether this is good or bad (the latter, most likely), we will limit ourselves to the problem of applying cost-accounting in each of them.

In the readers' opinion, cost-accounting can be most effectively introduced and developed in:

- academic institutes—15 percent;
- sectorial scientific institutes—52 percent;
- VUZ science—33 percent;
- cooperatives—80 percent.

Thus, academic science was assigned the least preference for cost-accounting. The point of this attitude towards the subject under discussion is relatively simple: the outcome of basic research is unpredictable and removed in terms of time. Who will finance it?.. One reader of our bulletin from Krasnoobsk speaks even more definitely on this: "The law on converting scientific research institutes to cost-accounting is unrealistic. Science is an assault force that society casts into the future, in order to know and correctly choose ways for its own development. The more rapidly society progresses, the deeper the assault force, i.e., science, has gone into the future. Moreover cost-accounting in science is a powerful way to hinder it."

V. Matviychuk from Vinnitsa expresses the opposite viewpoint:

"I think that basic science will not suffer from the introduction of cost-accounting, but will benefit."

Cost-accounting is destructive for science, one of the readers of the bulletin stated. However, he continued, it

needs science. The whole question lies in what cost-accounting is. In this respect, it is interesting to direct attention to the practice of implementing foreign projects, like "Evrika," "Aerobus," and "Konkord." For example, none of them could have managed without large subsidies from the state or private corporations. However, in the course of implementation, these projects give industry new materials, technologies, instruments and equipment, which in turn helps finance further projects and incentives for their participants.

In this regard, we agree with the opinion of V. Marusin from Barnaul, who thinks that the point lies not just in cost-accounting, but in the importance of one or another subject matter, its labor-intensiveness, novelty, scale... From this, one should proceed with defining sources and means of financing and with organizing work according to traditional or other methods.

The questionnaire on cost-accounting in science consisted of 17 questions. We will only examine a few of them in detail due to their complexity and, sometimes, their debatability. A large group of questions concerned the activity of scientific and technical cooperatives (NTK), which, at least today, are one of the alternative forms for implementing cost-accounting in science. The sphere of their activity, prospects for development, the division of labor between large scientific research institutes and design bureaus, and our readers' attitude toward the NTK is easy to see from this fragment of the survey's final table.

Do you think that the NTK and state scientific institutions can organically co-exist, sharing spheres of activity?

I think so	80 percent
I do not think so	13 percent
Hard to answer	7 percent

Can the NTK work more effectively in certain scientific fields, than state scientific institutions?

I think they can	92 percent
I think they cannot	6 percent
Hard to answer	2 percent

Do you believe it possible to convert large scientific research institutes and design bureaus to cooperative principles?

Yes, I think it is possible	58 percent
No, I do not think so	28 percent
Hard to answer	14 percent

If you were asked to work in a NTK, would you agree or not?

Yes	73 percent
No	27 percent

In your opinion, what form of scientific work would it be expedient to give to cooperatives?

Technical development of ideas	60 percent
Creating experimental models	62 percent
Testing new machines and technologies	57 percent
Application	71 percent

In conclusion we would like to direct attention to the following. A significant segment of our readers believe, not without grounds, that the NTK are draining the best cadres away from sectorial and basic science, the young and talented scientists who have experience in organizing scientific research. The same writers sometimes claim that the opportunity to realize their own calling and earn well for good work attracts young specialists to the NTK. Several of our correspondents ask, "Is this good?" We are, at least, sure that it is not bad. Yet, what in fact is the use, if the same talented scientist, engineer or researcher will, in time, have devalued the lethargy surrounding science with the normal average statistical temperature?

Something else is also noteworthy. Some of our readers direct attention to the fact that the development of the NTK is revealing the shortage of highly skilled cadres and even of decent people. This is probably a matter of time. Demand shapes supply. We hope to be able to discuss this in greater detail in 1989.

FROM THE EDITORS: We sincerely thank everyone who participated in the regular questionnaire survey.

Ovchinnikov Defended in Blood Substitute Scandal

18140158b Moscow SOVETSKAYA ROSSIYA in Russian 15 Jan 89 p 4

[Letter to the editors by Academicians S. Ye. Severin, V. T. Ivanov, A. A. Bayev, A. S. Spirin, A. L. Kursanov, and USSR Academy of Sciences corresponding member V. F. Bystrov: "A Substitute for Truth"]

[Text] LITERATURNAYA GAZETA (17 August 1988) and OGONEK (3 September 1988) printed articles on one and the same subject—the situation surrounding the creation of an artificial blood substitute preparation—"blue blood." The virtually simultaneous publication of frankly "expose-like" articles in two popular magazines was unquestionably counted on to create a one-sided concept of the essence of the case. The authors allow themselves to treat that which took place in a free style, setting forth the incentives for the actions of "involved" parties in such a way as to grip the heart of an unprepared reader. The television broadcast on "Projector of

Restructuring" (12 January 1989), directed by T. Komarova and N. Prokofyeva, was kept in the same key. The fact of this "mass" supply of information itself puts one on guard, forcing any open-minded person to think.

It is a question of a blood substitute, perphthoran, developed by the USSR Academy of Sciences Institute of Biophysics while G.R. Ivanitskiy, USSR Academy of Sciences corresponding member, was director of the institute and one of the leaders of the program for manufacturing this blood substitute. The working principle behind perphthoran lies in perphthor-carbons—synthetic substances, wholly alien to the organism, but possessing one valuable property—they dissolve oxygen and, when introduced into the blood stream, are able to supply the organism's tissues with the oxygen needed for life support under conditions in which blood is unable to do this, for example, when there has been massive blood loss. This was disclosed in foreign publications in 1968.

Chemists at the USSR Academy of Sciences Institute of Elemental Organic Compounds imeni A.N. Nesmeyanov, led by Academician I.L. Knunyanets, after doing a great deal of work to synthesize perphthor-carbons, created compounds which could be suitable for making blood substitutes. This chemical work was deemed useful and promising. Even now, the search for new perphthor-carbons continues. The key question of the whole situation, which was the subject of the letter from G.R. Ivanitskiy, USSR Academy of Sciences corresponding member, to LITERATURNAYA GAZETA, lies in the following: does "blue blood," in a form of a perphthoran preparation, exist as a blood substitute truly suitable for use? For now, the answer to this question can only be negative—this is the unanimous opinion of the experts. It should be emphasized that the final say on the question of using perphthor-carbon preparations should belong to the physicians and health care agencies. Neither journalists, nor biophysicists, nor the authors of this letter can judge this complex and responsible problem. One can only be startled by how easily and decisively the opinions of people who knowingly lack the knowledge necessary for this are voiced.

The perphthoran preparation is not a chemically homogeneous substance, but a medicinal mixture of several components, of which two perphthor-carbon compounds carry the oxygen and comprise the working basis. Very rigid requirements must be made of any preparation which lays claim to the role of a blood substitute, since it is needed in critical cases when a person lies at the brink of life and death. Incidentally, when the patient is in such a state, the harm that a poor quality preparation might cause could turn out to be imperceptible (accidentally or intentionally).

According to data from the USSR Academy of Sciences Institute of Biophysics itself, and judging by evaluations of similar preparations in the foreign press, perphthoran has several negative qualities as a blood substitute. Firstly, its oxygen capacity is low. It only absorbs an adequate quantity of gas in an almost pure oxygen atmosphere, which makes its useful application outside a hospital environment difficult. Secondly, the water-insoluble perphthor-carbons in the preparation exist in the form of miniscule spheres, whose size is strictly limited by physiological conditions. Moreover, the perphthor-carbon emulsion is unstable during storage and sterilization, for which reason the preparation cannot be considered sufficiently safe. Finally, in the third place, perphthoran as such cannot be sterilized either by high temperature, or by gamma radiation. When manufacturing it, all components must be sterilized individually and the mixture is then prepared under sterile conditions. Yet, this procedure is extremely difficult and unreliable. Besides the above, perphthoran also has some other shortcomings. So, it is possible to think that "blue blood," meeting strict requirements, did not exist in the past and does not today. Perphthoran is unsuitable for this role.

The USSR Academy of Sciences Institute of Biophysics, it must be admitted, overstepped the limits of its competence in carrying out the perphthoran program, since it tried to solve a purely medical task. True, in order to do this, a special medical biophysics laboratory was created at the institute, but it was an isolated cell, and the scientific council, the institute's body of scientific control and scientific democracy, was in no condition to competently judge all aspects of the laboratory's activity. In any case, the development of perphthoran for clinical use should not have been organized in the USSR Academy of Sciences Institute of Biophysics, since this is a task for special industries. The biological testing of perphthoran should not have been performed at the USSR Academy of Sciences Institute of Biophysics, since this should be done by independent experts, not the creators of the preparation. As far as rule violations in the testing and production of perphthoran are concerned, the report of their existence gave the USSR Prosecutor's Office cause to thoroughly investigate this matter.

The "perphthoran story" also has a psychological aspect, which to a significant extent explains the events that accompanied this ill-fated, although in many ways useful, research. It would be unfair to deny the existence of idealistic motivations among the collective members who participated in fulfilling the program, and to deny the fact that they were guided by an awareness of the difficulty and significance of the task, the joy of research along unbeaten tracks, and the understanding of the enormous benefit which the creation of a blood substitute and so forth would have. However, was everyone involved only because of this altruistic impulse? In particular, with the first glimmers of success, a stir could arise, as aspiration to achieve the desired goal and receive the glory and awards, which, of course, one could count on, in any way and in the shortest time. Such attitudes most likely did exist, and also led to a weakening in control and self-control, to a compromising attitude toward violations of rules in the certainty that success would cover up the sins.

As far as the author of the letter to LITERATURNAYA GAZETA, corresponding member G.R. Ivanitskiy, is concerned, his position should not be considered reasonable and justified. On the one hand, he acts as though nothing had happened, as though the violations, if they even existed, were purely formal; but on the other, he forgets that he was one of the program leaders and, consequently, should be responsible for everything that happened in connection with perphthoran, whatever what might have been, and cannot claim ignorance of the circumstances or incompetence on his part.

The following can be said about the role of Yu.A. Ovchinnikov, vice-president, academician, in the "blue blood" problem. In the portrayal by corresponding member G.R. Ivanitskiy, it was precisely Academician Yu.A. Ovchinnikov, motivated by practical considerations, who hindered the course of research on perphthor-carbons. These claims should be refuted as groundless. Existing documents attest to the fact that Yu.A. Ovchinnikov cooperated to the utmost in the development of work on perphthor-carbons from the very start. However, a time occurred when he, apparently, began to view it with suspicion. According to the impressions of people who were in close contact with him, Yu.A. Ovchinnikov finally stopped trusting G.R. Ivanitskiy and Professor F.F. Beloyartsev and followed the course of research on perphthoran with alarm.

Academician Ya.M. Kolotyrkin's memory regarding the USSR Academy of Sciences Presidium's committee for investigating the USSR Academy of Sciences Institute of Biophysics, which he headed, has betrayed him. In his words, Academician Yu.A. Ovchinnikov disbanded this committee, "...when members of our committee had succeeded in approaching a common stance and were preparing a draft conclusion..." In reality, the committee, created at the command of the USSR Academy of Sciences Presidium in January 1986, was unable to make any coordinated conclusion and its work simply halted with the illness of Ya.M. Kolotyrkin himself. It was only in November 1986 that Academician Yu.A. Ovchinnikov instructed the USSR Academy of Sciences Department of Biochemistry, Biophysics and Chemistry of Physiologically Active Compounds to finish the investigation of the USSR Academy of Sciences Institute of Biophysics (taking into account the documents of Ya.M. Kolotyrkin's committee), which was done.

Everything stated above attests to the fact that Academician Yu.A. Ovchinnikov had objective grounds for the instructions and actions which he implemented as USSR Academy of Sciences vice-president and chairman of the Presidium section.

This does not mean that we should abandon hope of obtaining a much-needed blood substitute using perphthor-carbons. Hope has not been lost and work in this direction continues, taking accumulated experience into account.

We sent a letter to this effect to LITERATURNAYA GAZETA. It has not been published. A letter, sent by the USSR Academy of Sciences to the editors of OGONEK regarding A. Ryskin's article, "The Price of Blue Blood" in No 36, was also not published. His letter stated that the problems dealt with in this article and its author's position conform in detail to corresponding member G.R. Ivanitskiy's opinions, of which he also notified the USSR Academy of Sciences.

Furthermore, the accusation of the late Vice-President of the USSR Academy of Sciences, Academician Yu.A. Ovchinnikov, of actions that allegedly led to the obstruction of the development of perphthoran and of other perphthor-carbon preparations and finally to the death of Professor F.F. Beloyartsev, repeating G.R. Ivanitskiy's claim, seems entirely unsubstantiated.

As everyone knows, Yu.A. Ovchinnikov believed that perphthoran was not yet fully developed, that it could not yet be a valuable blood substitute and that "pushing it into the clinic is dangerous and premature." The episode with the attempt to receive an State Prize, recalled in the article, relates to this aspect of the behavior of the developers, led by G.R. Ivanitskiy and F.F. Beloyartsev. The chemists at the USSR Academy of Sciences Institute for Elementary Organic Compounds did brilliant work in synthesis, but there was still no blood substitute preparation, just as there is none today. Therefore, there were no grounds for laying claim to a State Prize. Yu.A. Ovchinnikov's negative reaction was entirely warranted.

This all places Yu.A. Ovchinnikov's behavior in an entirely different light—he acted against G.R. Ivanitskiy and F.F. Beloyartsev sending an inadequately tested preparation into the clinics and demanded strict scientific behavior of them.

Any suggestions by the article as to Yu.A. Ovchinnikov's participation in the actions of USSR Minzdrav, the Prosecutor's Office and other departments are a fabrication inspired by G.R. Ivanitskiy, who previously voiced this opinion both verbally and in writing.

Thus: two publications have come out which level accusations at the USSR Academy of Sciences Vice-President. It seems, it was impossible to print even one line defending the late scientist in a single one of the articles. In our opinion, this one-sidedness does not meet the standards of glasnost.

From the Editors:

At the end of December, a special expanded meeting of the bureau of the USSR Academy of Sciences Department of Biochemistry, Biophysics and Chemistry of Physiologically Active Compounds, devoted to perphthor-carbon blood substitutes, was held.

The department bureau adopted a resolution stating that "work, conducted at the USSR Academy of Sciences Institute of Biological Physics, to study perphthor-carbon emulsions, has not solved the problems with replacing massive blood losses." A committee was established consisting of representatives from the USSR Academy of Sciences, the USSR Academy of Medical Sciences, the USSR Ministry of Health Care, and the USSR Ministry of Medical and Microbiological Industry. The committee was instructed to "evaluate previously developed preparations and accumulated experience in the field of perphthor-carbon emulsions," as well as "to formulate recommendations on this basis for further development in this direction, to avoid repeating mistakes and to direct research along the most effective paths."

Boris Paton Honored on 70th Birthday

Husak Presents Award

18140111 Kiev PRAVDA UKRAYINY in Russian 27 Nov 88 p 3

[RATAU dispatch: "CSSR Decoration for Academician Paton"]

[Text] For great services rendered in developing cooperation between the Czechoslovak and Soviet science, President of the CSSR G. Husak decorated AN USSR [UkSSR Academy of Sciences] President Academician B.Ye. Paton with the Czechoslovak Order of Friendship.

On November 25 the Order was presented at the CSSR General Consulate in Kiev. "In our country, they highly value B.Ye. Paton's contribution to the development of science, technology, and economics. Awarding of one of the highest CSSR Government decorations to a most prominent Soviet scientist is a logical expression of this fact", said General Consul M. Kovach.

The General Consul conveyed congratulations from his country's leadership, as well as wishes of long life and new creative successes for the good of technical progress of two fraternal countries. In his response Academician B.Ye. Paton noted that for many years the UkSSR Academy of Sciences has been successfuly cooperating with the Czechoslovak Academy of Sciences and Slovak Academy of Sciences, with whom Ukrainian scientists conduct joint research along many important directions. Nowadays this is of decisive importance. They conduct joint work in accordance with the Integrated Program of S&T Progress of CEMA Member Countries Up to the Year 2000. Czechoslovak scientists are also making a great contribution to solving problems in all five priority directions. "I am sure that Program implementation will make it possible for us in a very near future to realize a number of important projects that will make it possible for the fraternal countries to more successfully develop their national economies and improve their peoples' well-being", said Academician Paton.

Biography, Achievements Recounted

181401111 Kiev RADYANSKA UKRAYINA in Ukrainian 27 Nov 88 p 3

[Article by Vice President, AN USSR, V. Kukhar: "Creative Person's Horizons (UkSSR Academy of Sciences President Academician B.Ye. Paton is Turning 70)"]

It is always difficult to write about bright and versatile people like Academician Boris Yevgenyevich Paton. And it is impossible to fully cover the entire range of his creative interests and accomplishments and present his full image within a framework of a short article.

Boris Yevgenyevich began his scientific activities during the severe years of the Great Patriotic War. In those days life was teaching one to come up with correct and optimum solutions in the shortest possible time. Apparently it was during this period that the credo of his scientific activity - to proceed from comprehensive theoretical research to practical implementation - was laid. This is this main orientation of Academician B.Ye. Paton's creative work that has determined to a large extent his worldwide fame, as well as the contents of activities of the Ukrainian SSR Academy of Sciences, which he has been heading for over 25 years.

The sphere of Boris Yevgenyevich's interests is extremely versatile. Possessing vast knowledge and excellent analytical abilities, not only Boris Yevgenyevich quickly grasps the essence of scientific ideas and trends, but he adds new and valuable quality to them and skillfully directs them toward solving important and urgent problems.

Still, Academician B.Ye Paton's main interest is metallurgy and technology of metals. His all life has been devoted to this branch of science and practical activity. Comprehensive research that has now exceeded the boundaries of pure science and covers main directions of modern material science has been conducted for many years under his direction at the world-renowned Electric Welding Institute imeni Ye.O. Paton, AN USSR. This complex of works is based on fundamental achievements in mathematics, physics and chemistry. One can say with confidence that the high level of domestic welding science and technology is based on this strong scientific foundation, which widely uses the latest achievements in basic research.

Just a list of welding principles developed attests to a comprehensive approach to and skillful application of physical phenomena and chemical processes. Electroslag welding, radio-frequency and diffusion welding, explosive welding, electron beam welding. And one should add the development of welding materials for these processes, which required a comprehensive understanding of laws of behavior of various substances and of surface phenomena. Under B.Ye. Paton's direction, a broad spectrum of research was conducted on studying

the effect of thermal, mechanical, chemical and radiation factors on metals and materials. The depth and thoughtfulness of this research had laid the foundation for the broad capabilities of welding. However, welding in space and underwater welding demanded even more - one had also to take into consideration the actual conditions under which the work had to be conducted. Here too new and original design solutions and bright engineering findings were proposed. Electric Welding Institute equipment was put in space, and Soviet cosmonauts were the first to acquire a new vocation of "space welders".

Boris Yevgenyevich contends that the developing new technology is only "half a deal." It is important to train people to work with the technology. To do this, the Institute designed a trainer; using this trainer, one can quickly master the heights of welding skills. On Academician B.Ye. Paton's initiative, engineering centers and bases have begun their operation. Their function is not just to build equipment for specific production processes, but also to train the personnel for running the equipment.

A brilliant example of fruitful application of basic approach to solving practical problems is a wide use of resistance welding in a continuous process. A special welding complex "Sever" developed based on this principle presented itself in a good light in welding of main gas pipelines under the Far North conditions. Its high capacity, quality and reliability have attracted the attention of foreign specialists, particularly those in the USA.

Boris Yevgenyevich is very active in the development of new materials so urgently needed for the modern machine building industry and aviation and space technology. The electroslag technology has opened opportunities for manufacturing large size products, castings and parts with outstanding technical and economic parameters. Electron beam and electroslag surfacing turned out to be useful not just for new product manufacturing, but also for reconditioning of worn parts. This is an optimum way to extend the life of machines and mechanisms and save material resources.

Technological experiments in space conducted under Academician B.Ye. Paton's direction, using various equipment, have proven theoretical forecasts regarding the improvement of properties of organic and inorganic materials manufactured under zero-gravity conditions. This unique research opens the era of space technology of materials and converts science fiction into tomorrow's reality.

A specialist in the field of metal materials, Academician B.Ye. Paton spoke with bitterness at the 27th CPSU Congress of the fact that we hadbeen obsessed with "metallization" of our economy. To do this, one has to consume ever more energy and expand the mining of ore, coal and other raw materials. The world has taken a different route. The output and consumption of steel and rolled products in developed foreign countries steadily decrease, as nonmetal materials, and first of all polymer composites replace metals. What is the advantage of this? According to specialists' calculations, a ton of plastic pipes can replace four to five tons of steel pipes. Plastic pipes have high corrosion resistance - they will work for at least 50 years without insulation. Plasitc pipes are used in the most material-intensive spheres of activity, such as construction, water and gas supply, and irrigation and amelioration. This is another resource-saving reserve. With his characteristic energy Boris Yevgenyevich is not just campaigning for this approach. He himself is the initiator of research aimed at replacement of metal in industry; and he has started the work on developing equipment for welding of polymer pipes.

Among Academician Paton's interests are new composite materials, various heat resistant coatings and methods for their application, ceramic materials, superhard materials, and saving expensive metals by replacing them with new inexpensive materials with improved performance properties.

Like the entire country, the UkSSR Academy of Sciences is actively restructuring its work. And its President Academician B.Ye. Paton is once again the initiator and generator of new ideas. New principles have already become part of Academy's activities, from statutory regulations to the changed system of research planning and financing.

The experience in staging and conducting goal-oriented basic research and creating engineering centers and S&T complexes, the orientation toward important developments that revolutionize entire industries, i.e things that were originated on the AN USSR President's initiative in the last decade, have already become practice domain.

These are but several touches for a portrait of Twice Hero of Socialist Labor, Lenin and USSR State Prize winner Academician Boris Yevgenyevich Paton, who is approaching his 70th birthday. It is hard to describe in its full entirety the image of this man, who is dynamic, enjoys what he is doing and enjoys life with all its diversity. Inexhaustible creativity and profound patriotism are the scientist's inspiring traits and an example for a large number of people.